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ENHANCEMENTS AND SIMPLIFICATIONS OF MOTIVATIONAL AND STIMULUS VARIABLES IN AUDIOVISUAL INSTRUCTIONAL MATERIALS.

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DESCRIPTORS- *LEARNING THEORIES, LEARNING PROCESSES, LEARNING, LEARNING ACTIVITIES, LEARNING EXPERIENCES, LEARNING MOTIVATION, *INSTRUCTIONAL MATERIALS, INSTRUCTIONAL TECHNOLOGY, *INSTRUCTIONAL AIDS, AUDIOVISUAL AIDS, *RESEARCH PROBLEMS, RESEARCH METHODOLOGY, STIMULUS BEHAVIOR, HAMDEN, CONNECTICUT

THE THEORETICAL ORIENTATION OF THIS PAPER IS TOWARD STIMULUS RESPONSE (S-R) LEARNING THEORY, WITH EMPHASIS ON THE POLLARD-MILLER PARADIGM OF (1) DRIVE, (2) CUE, (3) RESPONSE, AND (4) REWARD. IN THE CONSTRUCTION AND UTILIZATION OF MEDIA AND TEACHING MATERIALS, THESE FOUR CONDITIONS REQUIRE THE EMPLOYMENT OF A NUMBER OF INSTRUCTIONAL VARIABLES. THIS PAPER DEALT WITH MOTIVATORS, REINFORCERS, CUE IDENTIFIERS, AND SIMPLIFIERS. OTHERS WILL BE CONSIDERED IN SUBSEQUENT WORKING PAPERS. THE AUTHOR HAS SUMMARIZED THE RESULTS OF EXPERIMENT CONCERNING THE SELECTED VARIABLES, AND HAS POINTED OUT PROBLEMS FOR FUTURE RESEARCH. THERE WERE SEVERAL BROAD AREAS RECOMMENDED FOR COMPREHENSIVE PROGRAMS OF RESEARCH, WHICH WOULD POSSIBLY EXTEND OVER SEVERAL YEARS. IN ADDITION, A NUMBER OF SMALLER AND MORE EASILY SOLVABLE PROBLEMS WERE SUGGESTED, SOME OF WHICH MIGHT BE SUITABLE FOR A MASTER'S THESIS OR FOR A PH.D. DISSERTATION. (JC)

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ENHANCEMENTS AND SIMPLIFICATIONS
of
MOTIVATIONAL AND STIMULUS VARIABLES
in
AUDIOVISUAL INSTRUCTIONAL MATERIALS

(A working Paper)

Mark A. May

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INTRODUCTION:

This is one of five working papers on research in selected areas of instructional variables recommended by the Educational Media Study Group at its meeting on September 24th and 25th, 1964. At this meeting, it was noted that recent reviews of the research literature on educational media indicate that, from the inception of the National Defense Education Act in 1958 to the present, the bulk of research sponsored by the Media Branch has been on evaluations of media programs and products with major emphasis on television and programmed instruction. Although a considerable number of analytical experiments on instructional variables has been supported, in relation to the total of some 300 research grants it has been relatively small. Most of the research that has been done on these variables was completed prior to the mid-1950s. (See reviews by Allen 1960, Lumsdaine 1963, Travers 1964, and Lumsdaine and May 1965)

The Study Group identified five problem areas in the field of instructional variables to which it was recommended that the Media Branch give special attention. They were: (1) Meaningful Verbal Learning, (2) Learner Response and Instructional Media, (3) The Picture-Word Relationship in Learning, (4) Enhancements and Simplifications, and (5) Sequencing and Organizing Content for Instruction. Each of these areas has been defined more specifically by members of the Study Group.

It was recommended that a working paper on each of these areas be prepared under contract with the Media Branch. Each paper will describe and evaluate the current state of knowledge in its area, identify unsolved problems and set up general specifications for future research. After each paper has been reviewed by the Study Group, decisions will be made concerning the advisability of awarding contracts for programs of research or for individual projects.

It was further suggested that future research in these areas be oriented toward the formulation of scientifically grounded principles to guide future productions. Variables involved in media productions should be carefully evaluated for their contributions to teaching effectiveness. Such evaluation can be made by comparing the effectiveness of alternate versions of a film or ETV program in which instructional variables have been experimentally manipulated. But film variables controlled by producers interact with utilization variables controlled by consumers and with audience variables controlled mainly by selection. So the evaluation of film variables must be more or less specific as to how the film is used, for what purpose, and with what kind of an audience. Some film variables, however, may be effective over a wide range of audiences and methods of utilization. The discovery of such variables is one of the main objectives of research that is oriented toward improved productions.

One set of variables that can be built into films and ETV programs is the enhancements introduced to (a) make the presentation more interesting, appealing, and rewarding, and (b) to facilitate identification of relevant cues and to emphasize them. Ordinarily such enhancements contain no additional information but are employed to increase the effectiveness of the informational content. Experiments testing the effectiveness of such enhancements will be reviewed in this paper.

Another set of variables in A-V presentations is the simplifications which eliminate all effects and devices that convey no additional information, or substitute simpler and more economical media for films.

The problem is to find, by experimentation, a balance between enhancements and simplifications that will maximize the effectiveness of a presentation for the achievement of its educational purpose. Over-simplification could result in loss of interest on the part of some learners, and over-enhancement may present irrelevant cues, distract attention from the relevant ones, or have some other unpredictable side effects that hinder rather than aid the effectiveness of the presentation.

A practical objective of research on A-V presentations is the formulation of a number of scientifically based principles that should serve as guides to future productions. Such propositions should be of use to script writers, production planners, film directors and editors. These guides may be of two kinds, those based on generalization derived from past research, and those based on theoretically relevant variables which have been tested experimentally. For example, script writers should be aware of the experimental results on the readability of a script; production planners should know that experiments indicate that color adds little or nothing to what is learned from a film in classrooms; and editors should know that optical transitional devices are not effective. But later experiments may modify these results. Theoretically relevant variables grounded on a science of learning and tested under a variety of practical conditions should be more dependable than many of the results derived from previous research.

There is need for more experimentally produced films. Only three instances are found in the experimental literature. (Gropper and Lumsdaine 1961, Edling 1963, and Levonian 1963) When teaching materials are experimentally tailored to the needs, interests, abilities, and personality characteristics of learners, the resulting products have proved very effective. In each of these cases, the productions were guided by principles of learning.

One of the reasons why programmed verbal materials have been so successful and widely used is that they are based on certain fundamental principles of learning. But these principles can be applied in so many different ways that the ultimate test of the effectiveness of a program is how well it works in practice.

Theoretically relevant principles and variables are not altogether lacking for use in the production of A-V materials. They have been enunciated by a number of psychologists including Miller et al (1957), Kendler, Kendler and Cook 1951, Skinner 1960, Sheffield 1961, Lumsdaine, 1962 and 1964, Carpenter 1957, Travers 1964, Hilgard 1964, and others. But relatively few experiments have been designed to test the effectiveness of these theoretically relevant variables.

The theoretical orientation of this paper is toward S-R learning theory, with emphasis on the Dollard-Miller paradigm of drive, cue, response and reward. The practical conditions of effective learning from any media-communicated presentation are: (a) the learner must give it his active, undivided and sustained attention; (b) his attention must be focused selectively on the relevant and significant aspects -- i.e., on the cues presented in the aural and visual aspects as they occur; (c) he must put forth an effort to associate these cues with the to-be-learned responses as they are given by the narrator and seen in the picture; (d) for difficult verbal material and for the acquisition of perceptual motor skills some form of practice or overt responding is required. These four types of responses must be fixated by some form of reinforcement.

In the construction and utilization of media communicated teaching materials these conditions require the employment, of a number of instructional variables. This paper deals with four of them: motivators, reinforcers, cue identifiers, and simplifiers. Others will be considered in subsequent working papers.

Motivators are the devices, effects, and procedures that perform the functions of eliciting the responses that are essential for learning from A-V presentations. As indicated above, these responses are of four main kinds. First are the responses of looking and listening -- i.e., paying close attention. Stimuli that elicit these responses may be called "attention-gainers" and "sustainers". Second, the learner must be motivated to scan and search the complex patterns of stimulation for the relevant and crucial cues. He must not only just look and listen but must be looking and listening for something. Such response may be labeled "selective attending" or "attention-focusing". Third, when attention is focused on the crucial cues and the to-be-learned response is given by narrator, or in the visuals, or both, the learner must be motivated to grasp the relationship and try to remember it. This is sometimes called "the effort" to learn, or the "set" to learn. Although the responses involved in grasping a presented relationship and remembering it are largely covert, they are none the less essential conditions of effective learning from teaching materials as contrasted with incidental learning from commercial TV. Fourth and finally, when provision is made for overt responding or practice, the learner must be motivated to participate.

Reinforcers. Learning from an A-V presentation cannot be said to occur unless the to-be-learned responses are so strengthened and fixated that they will be given to the cues in the test situation. They must be strong enough to overcome all competing responses that may have been previously associated with these cues. They must be reinforced. Perhaps the most useful definition of a reinforcer is any stimulus, or state of affairs, occurring in contiguity with the stimulus-response process, that increases the probability that the correct response will be given in the test situation. Most of the reinforcers that operate in classroom situations and in learning from A-V presentation are acquired. The most common ones used by teachers are responses to stimuli such as smiles, words of praise and commendation. But because such reinforcers have been learned, there are wide individual differences in their effectiveness. Each child's inventory of acquired reinforcing stimuli is unique, and therefore, the number in common to an age group of a particular type of home background is fairly limited. This presents a problem of how to build reinforcers into films. One rule of thumb is to make the presentation as attractive and appealing as possible so that the experience of learning will be rewarding. But as we shall see later, the correlations between liking and learning are not very encouraging.

Cue Discriminators and Emphasizers are devices and effects built into films that help the learner to identify and recognize the relevant cues. Included here are such aids as arrows, pointers, and marks of transitions.

Simplifiers are procedures for making presentations more effective by improving the "readability" of the narration, eliminating irrelevant pictorial materials, or substituting filmstrips or filmgraphs for films.

The experiments reviewed in the following pages are classified under the four headings of motivators, reinforcers, cue identifiers, and simplifiers in the full recognition that the same experiment could be included in more than one of these major categories. Color, for example, could function either as a motivator or cue identifier depending on how it is used. The story form format may perform both the function of a motivator and a reinforcer by the process of identification with a protagonist. This classification is used primarily to call attention of investigators to the need for choosing experimental variables from the standpoint of the function or functions that they are supposed to perform.

PART I

MOTIVATORS

BUILT INTO FILMS

Reviewed here are experiments testing the effectiveness of devices and effects built into films and ETV programs primarily to make them more appealing, interesting, and satisfying. Included are experiments on color, dramatic presentation, humor and comic effects, and musical background. Reasons for supposing that these devices and effects would facilitate the learning and retention of the subject matter, arouse a desire to know more about it, or have some other positive effect are usually not stated by the experimenters. Some, however, may have proceeded on the assumption that, since motivation and reward are believed to be important conditions of instrumental learning, any device that would enhance these variables would be expected to improve learning. But as indicated above, the effectiveness of a motivator depends on the kinds of responses that it drives out. While facilitating the response of attentiveness, it may at the same time inhibit the effort to learn by evoking the competing response of relaxation.

1. Color.

Color could serve one or more of three functions. First, it could be a motivator for gaining and sustaining attention. People generally prefer color movies and spend extra money to purchase color TV sets. Second, it could serve as a reinforcer by contributing to "a satisfying state of affairs" which, according to the learning theories of Thorndike, Hull and others, is a source of reinforcement. Third, it could be an important aid to cue identification and emphasis.

Five experiments have been reported in which a color version of a film has been compared with its black and white counterpart. One was by Lumsdaine (1958), two by VanderMeer (1954), and two by Rosenstein and Kanner (1960 and 1961). All are in agreement that the mean gain of information from black and white versions was about the same as the mean gain from color versions. One of VanderMeer's experiments did, however, indicate that the mean gains retained from the color versions in two out of five films used were reliably greater than the mean gains retained from their corresponding black and white versions.

In three of the experiments - one by VanderMeer and the two by Rosenstein and Kanner - an effort was made to assess the cue-identifying and emphasizing effects of color. A review and evaluation of these experiments will be given in the section of this paper on cue identifiers.

In the experiment by Lumsdaine and VanderMeer the motivating effect of color was measured roughly by having the experimental subjects rate each version on how well it was "liked", and on "interest" in the subject matter. As to the reinforcing effects of color, ratings for "liking" or "interest" are not valid measures of reinforcement as will be seen in the section on reinforcement. How valid they are as measures of motivation is not known. They are reported here for whatever they may be worth.

Lumsdaine used three scales for measuring the evaluations of a color and black and white version of the film, Seasons. One called for a rating on a 10-point scale indicating how well the film was liked in relation to all other instructional films that the subjects had seen; on the second scale, the versions were rated for interest in subject matter; and on the third for how well the subject matter was understood.

Mean ratings on interest in the film by ninth grade students were 7.2 for color and 7.6 for black and white; for fifth graders they were 5.6 for color and 5.5 for black and white. Interest in the topic - the seasons - was rated both before and after seeing the versions. There were no reliable differences either between versions or between pre- and post- film ratings. Seeing the film in either version did not increase interest in the topic. A similar result was obtained from ratings on how well the subject-matter was understood.

VanderMeer used five films in his first experiment and four in a second. Their titles were: Maps are Fun, How Man Made Day, Rivers of the Pacific, Snakes, and Sulphur and Its Compounds. Two procedures for measuring liking for alternate versions were employed. The subjects in his first experiment were shown a reference color film on Five Colored Birds. They rated it for how well it was liked. After seeing a version of each of the experimental films they were asked to rate it on whether it was liked better or worse than the bird film. In his second experiment VanderMeer rotated both subjects and film versions so that each subject saw two color versions and two B&W versions. Each was asked to tell whether he liked the color ones better than the B&W ones. By pooling these paired-comparisons for all subjects and overall four films a kind of average overall rating was computed.

A film by film comparison between color and B&W versions showed no reliable differences in means of ratings by subjects who saw the color versions and those who saw the B&W versions, when the first technique was used. When the second technique was used the color versions were rated higher than the B&W versions, and for two of the films - Snakes and Sulphur - significantly higher. These were two of three films in which color contributed to cue identification.

These three experiments suffer a number of shortcomings and limitations that require further investigation before it can be safely concluded that color adds nothing to how well a film is liked or to amounts of information gained from it. Among the more obvious ones are (a) comparisons have been made on only six instructional films which may be far from a random or representative sample of all instructional films, (b) the experimental subjects were in grades five to ten which is not representative of entire school populations, (c) in only one of the experiments was a test of delayed recall used, which indicated the only positive result in favor of color that was obtained, (d) the films were shown to captive audiences and in learning situations where motivations to pay close attention and learn were already so high that color could have added little or nothing to them, (e) whatever motivating contribution color might have produced was cancelled out by distracting attention away from the relevant cues, and (f) no comparisons have been made between color and black and white versions of so-called "motivational" films which are designed to change attitudes or to motivate subsequent learning activities.

A less obvious shortcoming in these experiments is their molar character. They were not designed to ferret out the various kinds of responses involved in learning from A-V materials that might be elicited by color stimuli. Such stimuli could activate sensory-perceptual responses of looking and listening, and at the same time relax those involved in effort to learn and remember. It could be that the stimuli presented by pretty pictures such as seen in the movies and on TV could have become conditioned to a kind of generalized "relax-and enjoy it" response. A great many ingeniously designed experiments are needed to separate out the different effects that color, or any other motivational device, may have on the different conditions of learning from A-V material.

The type of basic research that is needed is illustrated by a recent experiment by Chan, Travers, and Van Mondfrans (1965). Two lists of nonsense syllables were presented simultaneously in pairs - one visually and the other aurally. For example, while seeing the syllable JEB, the subject heard the syllable ZAS. There were eight such pairs. Two versions of the visual were prepared, one in black and white and the other in colored letters on novel colored backgrounds. The subjects were 166 students in introductory psychology assigned at random to the colored and black and white versions. Each subject got ten trials at learning the list of eight pairs. The results were (1) more of the visuals were learned than the aurals under both conditions of visual presentations; (2) about 2/3rd as many aurals as visuals were learned when the visuals were black and white; and about half as many when the visuals were in color; (3) the total of visuals and aurals were the same under both conditions. Thus, the gain in the colored visuals over the aurals was at the expense of the aurals.

This result could be interpreted to mean that the colored visuals tended to distract attention from the aurals more than did the black and white visuals.

2. Dramatic Presentations.

The dramatic story-form format commonly employed in entertainment movies and TV programs has proved, more by experience than by experiment, to be a powerful one for gaining and holding the attention of large audiences. Children accustomed to seeing many such presentations often complain that educational films and ETV programs are dull and boring.

This format has been used in a few instructional films in which live-action lip synchronized dialogue has been employed instead of the more conventional off-stage narration. Its presumed advantages are a more interesting and rewarding presentation and an opportunity for vicarious learning by identification with a protagonist. The off-stage narration format, on the other hand, has the advantage of being simpler, less costly to produce, easier to modify after production, and more readily translated into other languages. Unless, therefore, the live-action dialogues format can be shown to be much more effective for imparting information and demonstrating skills it could hardly be recommended over simpler ones.

Only one experiment has been reported in which an off-stage narrated version of a live-action dialogue film, retaining all of the verbal and most of the pictorial contents, has been prepared. Lumsdaine (1958) succeeded in doing this in a fairly satisfactory manner with the instructional film Seasons which was produced originally in live action and in color. (This is the same film that was used for comparisons of color vs. black and white versions). The off-stage narrated version was produced in black and white and compared with the black and white version of the original.

Each version was seen by randomly selected halves of classes of fifth and ninth grade pupils. (N-160) Immediately after each showing pupils were asked to rate it on each of two scales, one for degree of interest in the film itself and for interest in the subject-matter. All pupils including a control group that did not see either version, were given a 56-item information test which had previously been refined for sensitivity and reliability.

The fifth graders rated the live-dialogue version higher than the narrated one on both scales, but the ninth graders rated it quite a bit lower on interest in the film and slightly higher on interest in the subject. The live-action format appears to have appealed more strongly to the younger pupils.

The mean score of the fifth graders on the 56-item information test was slightly higher for the narrated version (the one they liked least); and the ninth graders scored slightly higher on the live-action version (the format which was liked least). Although these differences were slight and not reliable, they do suggest a possible negative correlation between liking and learning. This relationship will be discussed more fully in the next section of this paper.

Lumsdaine (1958) suggests that perhaps one reason why the fifth graders scored slightly lower on the version they liked best (live-dialogue one) was that their interest in the actors distracted their attention from the essential aspects of the material.

The three actors in the dramatic version were a boy and a girl, fourth or fifth grade pupils, who were taught by their father by the Socratic method of question and answer. It was assumed that because the boys in a class would identify with the boy in the film, and the girls with the girl, they would rehearse mentally the answers given to the father's questions. This expectation is based on a rather common observation that children do learn by observing the answers that other children give to the teacher's questions, and by noting how the correct ones are rewarded and the incorrect ones disapproved. To discover whether or not this reasonable expectation was confirmed by the above experiment would require more detailed information than was obtained. For example, were the girls in the classes which saw the live-dialogue version more attentive to the performance of the girl than to that of the boy, and vice versa? What kind of a boy or girl were these two actors perceived to be? Did seeing them learn increase the motivations of the pupils "to be like" the protagonists and to learn like they did?

Identification with a protagonist may not be the crucial factor in learning from a live-action dialogue presentation. The dramatization of important points, regardless of who does the acting, may be a more vital aspect. This is illustrated by one or two sequences in the live-dialogue color version of the Seasons film. The boy is shown making two mistakes in carrying a globe around a lamp to illustrate the change in the position of the earth relative to the sun from December to June. First, he starts the wrong way - i.e., clockwise, and second, he holds the globe so that its north pole is tilted away from the lamp representing the sun. The father corrects both of the errors and the act is repeated correctly. Later in the film, the girl makes the same two mistakes in changing the position of the globe from spring to fall. Again these errors are corrected and the action is repeated correctly. Test items covering facts and explanations taught by these two sequences show much larger gains than were made on any other parts of the film by both fifth and sixth grade pupils. The materials to be learned were both "talked out" and "acted out" simultaneously, and repeated once over. In the narrated version, minus actors but with action and description the same, these two facts - clockwise movement of the earth and tilt of its axis were learned about as well as they were from action-dialogue version.

This raises an important question for the production of instructional and demonstrational films, and ETV programs. Under what conditions, if any, does the on-stage presence of the narrator or teacher enhance learning?

3. Humor and Comic Effects.

During World War II several films and filmstrips were produced to aid in the rapid training of large numbers of civilian and military personnel. Some of these were on topics deemed to be dull and relatively uninteresting, and often they were shown under conditions unfavorable to learning, as for example, when trainees were tired and sleepy. In order to overcome the effects of dullness, drowsiness, and apathy, some of them were adorned or "jazzed up" with humor, and comic effects.

Two experiments have been reported in which the original comic version was compared with a modified version from which the comics were omitted. One was by Lumsdaine and Gladstone (1958) on an Army-produced filmstrip designed to teach the phonetic alphabet. The other was by McIntyre (1954) on the film, Cold Weather Uniforms.

The original sound filmstrip for teaching the phonetic alphabet (Able for A, Baker for B, etc.) contained humourous comments, comic cartoons and a musical background. In the modified version, each letter and word pair was simply printed on a neutral background, and each was pronounced by the narrator as it occurred. In both versions, after six or eight pairs had been presented, a review frame was introduced. After the entire list was shown, a test was given requiring each trainee to write the correct word after each of the letters.

Each version was shown under two conditions of learning. At each review frame one group of subjects simply looked and listened to the correct pronunciation of each pair as it was shown. This was called passive review. A comparable group were required to pronounce each letter-word combination out loud. This was called active review.

The subjects were eight companies of military trainees at Fort Dix, New Jersey. Eight comparisons were made between the "plain" and "fancy" versions, and eight between active and passive review. Active was superior to passive on seven out of eight comparisons; and the "plain" version yielded better learning than the "fancy" one, especially for trainees with lower mental abilities.

The original version of the film, Cold Weather Uniforms, used by McIntyre (1954) shows a stupid character making all kinds of mistakes which are corrected and commented on, "Pete Smith" style, by an off-stage voice. Two modified versions were prepared. In one, the comic sequences were replaced with printed titles which were read aloud by the commentator. In the other modified version, the printed titles were replaced with blank film and the information given by the commentator.

Each version was shown to comparable groups of military trainees (N-426). Each group was given a 64-item information test and an opinion questionnaire on how well the version was liked. The version in which printed titles were substituted for comic sequences produced significantly more learning than either of the other two. Some of the subjects were shown both the humorous version and the one with the titles. Their preferences seemed to be for the one they saw last.

The results of these two experiments are not sufficient to justify ruling out, once and for all, the employment of humor in media teaching materials. In presentations that require sustained attention for thirty minutes or longer, some students have a tendency to let their attention to wander. Humorous interludes, carefully interspersed and timed, could be very effective in regaining lost attentiveness. Many lecturers know this and do not hesitate to use humorous remarks precisely for this purpose. So humor and comics might best be considered not so much attention gainers and sustainers, but attention regainers.

4. Musical Background.

Only one experiment on the effects of a musical background on a film has been reported. Tannenbaum (1956 AVCR IV-2) presented a one-act play in three ways. It was viewed live on the stage; filmed when presented on the stage; and presented in a studio TV version. Each presentation was prepared with and without a musical background. Six groups of college undergraduates were subjects. For each of the three types of presentation there were two groups of which only one heard the musical background. Each group was asked to rate the play on a series of Osgood-type semantic differential scales containing items that measured, activity, potency, and worth (evaluative). The results showed that musical background versions were rated as more active on each of the three types of presentations. The versions with musical background were also rated as more powerful or stronger than the musical versions. But the effect of music on the evaluate scales was negligible.

Also, with or without musical background, the filmed stage version was rated lowest and the TV-Studio version highest, with the stage version in between. Apparently, musical background had no effect on how the play was liked but did have a marked effect on whether it was considered lively and powerful. This experiment illustrates the importance of discriminating between the various types of effects that a presentation may have.

Zuckerman (1947) has made an analysis of the rather extensive literature dealing with the effects of music on audiences. Three types of effects were identified: (1) establishing an atmosphere or mood, (2) pointing up dramatic highlights, (3) enhancing the emotional tone of incidents. Members of audiences who identified the music derived satisfaction from being able to do so. Zuckerman concluded that the effects of music are so diverse and intangible that it is extremely difficult to isolate and measure its variable effects.

5. Inserted Printed Questions.

Here is a device for enhancing motivation to pay close attention and learn in a manner that avoids the possibly distracting effects produced by enhancements such as color, live-action dialogue, and humor. May and Lumsdaine (1958) prepared three experimental versions of an instructional film on The Heart and Circulation of The Blood. First, the contents of the film were organized into seven units or "blocks" of information each of which was preceded by a printed title - e.g., "The Heart's Valves".

In Version 1 a motivating question was inserted at the beginning of each section, usually in the form of "Do you know that...?" or "Do you know why...?", implying that if you pay attention to what follows you will find out.

In Version 2 a "participation" question was inserted at the end of each section asking the student to indicate what had been learned. At this point the film was stopped briefly so that the pupils could answer on prepared answer sheets. After a short interval the correct answer was flashed on the screen and read by the narrator.

Version 3 employed both forms of questions.

The original version and each of the three prepared versions were shown to comparable groups of tenth and eleventh grade pupils. Gains in knowledge were measured by a 40-item objective test covering the contents of the film. It was administered before and after each showing. In order to avoid the possible motivating effects of a pre-film test, the items were camouflaged by mixing in among them a number of irrelevant ones on general science. Gains, measured in terms of average number of correct answers for each group, from the pre-test to the post-test, were: for the original version, 8.2%; the version with motivating questions, 10.5%; the version with participation questions, 12.2%; and the one with both types of questions, 14.0%. However, when the original version was shown twice the percentage of gain was 12.0%.

When these results are compared with those obtained from the experiment on the phonetic alphabet, it will be noted that here the motivational device had a positive effect. This could be due in part to camouflaging the pre-test questions, but more important is the fact that the motivating questions directed attention to the learning task instead of away from it.

While the motivational questions might have caused the learners to look more closely and to listen more carefully, there is another device that could have contributed to the improved learning. The fact that the film was divided into seven parts, with titles separating each part and motivating questions immediately following each title, had the effect of distributing learning by parts. However, pauses interpolated in learning sequences tend to reduce and dissipate what Hull called "reactive inhibition" by providing rest periods. This raises the question as to whether or not blank film in the place of motivational questions would have produced equally good results.

McGuire (1961) tested this hypothesis by comparing rest pauses with pauses filled with motivating statements. The experimental materials were nine slides, each containing a picture and the name of a part of an automobile fuel pump. Immediately after the list was shown the subjects were tested with pictures only and required to give the name of each one. This was repeated six times.

Six groups of subjects were used. For three, the presentations were fast, at the rate of one slide every two seconds; for the other three groups the rate was one slide every four seconds. For one of the fast groups and one of the slow groups there were no interruptions in rate of presentation; for one fast and one slow group there was a rest pause after the third and sixth slide; and for one fast and one slow group this pause was filled with a motivating statement such as, "try hard to memorize the names and get a good score". The best result for the three fast groups was the pause filled with a motivating statement, and the poorest was no pause. For the three slow groups, the pause alone and pause with a motivator were about the same but both better than no pause. The overall results show that the three slow groups learned better than the three fast groups.

These experiments illustrate how difficult it is to separate out the motivating effect of a device from other positive effects resulting from its introduction. While the use of motivational questions may avoid the distracting effects of other devices, they immediately encounter the additional positive effect indicated by McGuire's experiment. A similar result was obtained by Kurtz, Walter & Brenner (1950) - Tech. Reports 269-7-16. They varied the frequency of occurrence of printed statements and participating questions in each of two films. In one version, a multiple choice participation question occurred every 32 seconds, in another version every 64 seconds. In a third version, a printed statement occurred every 32 seconds, and in a fourth every 64 seconds. Six experimental groups were employed, one for each of the four versions and one who saw the original film once, and another who saw it twice. A 70-item information test was given immediately after each showing. A delayed recall test was given later.

The modified versions yielded slightly better results than the original versions, but showing the original twice made up for this deficiency. Differences between versions on immediate recall and delayed recall were about the same, but all mean scores on delayed recall were lower. On the modified versions items emphasized by inserted questions or statements were learned better than items not so emphasized when compared with the original version, shown once; but this differential effect did not appear when the original was shown twice.

6. Relevant and Irrelevant Attention-gaining Devices.

It is reasonable to suppose that attention-gaining and holding devices that are relevant to the content of a film would be less distracting and more effective than devices that are irrelevant to the content, either in the visual or the auditory components. Neu (1950) tested this hypothesis by constructing alternate versions of a military training film on the measuring instruments used in machine shops. The basic version had no special attention-gaining devices. The modified versions were: (a) one with relevant visual devices, such as extreme close ups, zooms, stop motion, finger pointing, and novel camera angles; (b) one with irrelevant visual effects such as a pretty girl; (c) one with relevant sound devices such as ratchet sound heard in a machine shop, alternating voices on the commentary, slow and emphatic narration; and (d) one with irrelevant sound devices such as train whistles, pistol shots and bursts of music.

The subjects were 2631 servicemen. The post-film tests contained both verbal items and pictorial testing situations. The results show that the Army groups who saw the original straightforward version, unadorned with any of these devices scored significantly higher on the tests than either of the groups who saw the modified versions. The lowest mean score was that of the group who saw the versions with the irrelevant sound effects. For the Navy trainees, the mean scores on the original version were superior to those on the versions with irrelevant devices, but not significantly different from those with relevant ones.

Although relevant devices appeared to be more effective than irrelevant ones, they added little or nothing to amount learned. The fact that the subjects remembered them and could name them would indicate that they distracted from learning. The film presumably was designed to teach the names of the instruments, the purposes for which they are used, and how they are used. The devices could have facilitated one or two of these objectives, and inhibited the learning of others. The devices not only added little or nothing to overall attentiveness of these "eager beaver" trainees but acted to cause them to learn the devices rather than what they were supposed to learn.

PRE-FILM MOTIVATORS

A number of experiments has been reported in which procedures for gaining and directing attention and for motivating pupils to learn were not built into the presentation but manipulated by the experimenter. Two kinds of procedures have been used, those for motivating learners to pay close attention and try to learn and those for defining the learning task by directing attention to the relevant parts of the presentation. The main results of these experiments have been summarized by Allen (1955).

1. Announcement of a Post-test.

Allison and Ash (1951) tested three strengths of motivating instructions or three groups of college students in psychology (M-480). One group was told that the film was very easy because it had been made for high school pupils, and that some post-film questions would be asked. A second group was told only that a test would be given after the showing. The third group was told that the film was very hard and was intended to separate the good student from the poor ones and that after the film a stiff test would be given and the score of each pupil would be read aloud before the entire class. A control group that did not see the film also was given the test.

Prior to the showings all groups were given a general intelligence test and a Manifest Anxiety Scale. Control for scores on these two variables was handled by analyses of covariance.

The percentages of correct answers on the post-test that exceeded the mean percentage of the control group were 15%, 18%, and 23% respectively for the three levels of motivation. The anxiety-producing instructions were obviously the most effective.

Using the film Pattern for Survival, with 8 experimental and 3 control groups of seventh and ninth grade pupils, Michael (1951) found that the announcement of a post-test had no significant effect on the amounts learned. One factor that could have accounted for this result is the high intrinsic interest in this type of an anxiety-arousing film.

2. Knowledge of Pre-test Results.

In an experiment with some 3400 Navy recruits, Stein (1952) found that knowledge of scores on a pre-test substantially increased learning when the post-test items were identical with those of the pre-test. For a film on measuring instruments, the gains were 19% better than showing the film without knowledge of pre-test results, and for another film on the weather the excess gain was 27%. These gains exceed those from showing the films twice without knowledge of pre-test results by 12% and 18% respectively. Also these gains held up very well on delayed recall. However, a control group that had the same pre-test treatment - i.e., knowledge of results - but did not see either of the films, scored almost as high on the post-tests as the groups who saw the films. This suggest that knowledge of scores on a pre-test provided a considerable amount of learning.

3. Knowledge of Post-test Results Between Two Showings.

Procedures used both to motivate learning and to direct attention to the primary learning tasks have been employed in experiments by Wittich and Fowlkes (1946), Hovland, Lumsdaine and Sheffield (1949) and by Lumsdaine (1958).

Wittich and Fowlkes used two levels of motivation and attention-directing in a series of experiments using 27 films on science and social studies in grades four to six. First, before a film was shown the pupils were told briefly of its contents and special attention was given to the difficult words and phrases. After the film was shown, a post-test was given. The second procedure was the same as the first except that after the post-test the questions were reviewed and the film shown a second time, and then another test was given. Control groups saw the same films but without either of these two treatments. The first procedure yielded an increase in amounts learned over the control group of 28% and the second treatment added 40% (See Allen 1955 p. 185).

Hovland, Lumsdaine and Sheffield (1949) compared the relative effectiveness of pre-film instructions and motivating announcements with review exercises following the showing of a 43-minute Army film on Map Reading. Both procedures yielded significantly more learning than the film alone. The introduction method was slightly better than the review. When socres on test items of topics covered in the introduction were compared with those on topics not covered, the former were somewhat higher but significant gains were made on both, indicating that the introduction had an overall motivating effect.

Procedures for directing attention reported by Lumsdaine (1958) were: (1) verbal instructions to attend to the different aspects of a film, (2) pre-film test questions, (3) using the results of a post-test to direct attention to errors to be corrected by a second showing.

Directing attention by verbal instructions was used with the TFC film, David Copperfield - The Boy, which contains three identifiable types of subject matter, the main characters in the story, the plot or sequence of events, and the setting which is characteristic of life in 19th century England. Three classes of high school English students were used. Each was assigned to attend to only one of the three types of subject matter. A comprehensive test covering all three types was administered. The mean score of each group on the parts to which attention was directed was significantly higher than on the other two parts, but a considerable amount was learned from the two parts to which attention was not directed. This raises an interesting question. Why was it that a great deal was learned from parts or aspects to which attention was not directed?

The second procedure used by Lumsdaine was to split the pre-test into two halves and give one group the odd numbered items and a comparable group the even numbered ones. It was assumed that each group would look for the answers to its questions when the film was shown. The post-test covered both halves of the pre-test. Three different instructional films were used, two for students in the eighth grade and one for college students. The total amount of information, measured in terms of room for improvement, gained by all classes on all tests was 40%. An appropriate computation indicated that the percents of average gain to be attributed to directed attention for each of the three films were about 50%, 40% and 10% respectively.

The question now arises as to whether gains attributed to the effects of the pre-film tests were made at the expense of parts to which attention was not directed. From another experiment, designed to test this possible effect, it was found that the parts to which attention was not directed were learned somewhat less well but not significantly so.

The third procedure employed by Lumsdaine consisted of showing a film, giving a test on it, scoring the test, selecting the ten hardest questions, giving these questions to an experimental group for study but not to a control group, showing the film a second time, giving a post-test containing the ten questions, and comparing the results with those obtained by the control group. The experimental group gained significantly more than the control group not only on these ten questions but on other items as well.

The considerable amount of learning on parts to which attention was not directed, in both of the preceding experiments, indicates that these procedures operated to raise the general level of attentiveness as well as directing it selectively. It would appear that the attention-directors also operate as learning-motivators.

This result suggested that even better results might be obtained by showing each student his entire pre-test with the wrong answers marked conspicuously and permitting him to study it before the re-showing of the film. The controls were given something to read while the experimentals were studying the answers they gave on the first post-test. The result was indeed surprising. Both groups made substantial gains from the re-showing, but the controls gained slightly more than the experimentals.

Results that fail to support a prediction are always challenging and sometimes very instructive. These negative results, so the author speculates, could be attributed either to the de-motivating effects of complacency or despair, or to the distraction of attention created by reviewing both the correct and incorrect answers. The result also could have been due, in some part at least, to the well-known regression effect produced by the unreliability of the test.

All of these experiments, except the last one, confirm the hypothesis that amounts learned from certain parts of a film can be substantially increased by use of pre-film attention-directors. These pre-film procedures also tend to raise the over-all level of attention.

All the films used in these experiments were informational. Similar results have been obtained with training films in experiments where pre-film and between-showing tests were given. In the experiment on micrometer reading by Lumsdaine, Sulzer, and Kopstein (1961) a short pre-film test emphasising the critical learning objective was given to half of the subjects. These subjects scored significantly higher on the post-performance test than the control half. Kimble and Wulff (1963) also studied the effects on learning of a between-showing test, using the training film, How To Use a Slide Rule. First, a preliminary film explaining the different scales on a slide rule and how they are read was shown. Then a test on this was given to half of the subjects. Then came the film which taught not only scales but how to use them to multiply and divide. On the post-test the experimentals showed greater gains than the controls on scale reading items but not on computational items. This indicated that the interpolated test had a specific attention-focusing effect and not an over-all attention-intensifying effect.

This experiment and all others that have employed attention-directing procedures, either before showings or between showings, should be evaluated in terms of the extra time required. Allen (1955) has compared the percentages of gains in learning attributed to some of these procedures with percentages of additional time required. He found that in the experiment of Wittich and Fowlkes, and in that of Hovland, Lumsdaine and Sheffield, reported above, that the percentage of extra time taken by attention-directing procedures exceeded the percentages of improvement on test scores over that of control groups. This raises the troublesome question as to whether this extra time could have been better employed with some other activity such as provisions for overt responding. So one of the reasons why pre-film tests and between showings tests have yielded better results than built-in motivators is the increased learning, or motivating, time that was devoted to them. Yet on the other hand, as will be pointed out later in this paper, introductory sequences in films containing attention-directing and motivating devices have been found to have little or no effect on amounts learned. But the introductory sections that have been tested were relatively short in relation to total running time of the films.

EVALUATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Although in the experiments reviewed in the preceding pages the built-in devices and effects for gaining and sustaining attention and for making the viewing experience more rewarding have created no substantial improvement in liking or learning, it would be premature to conclude that they are totally worthless and should be omitted from all future productions. Further research may indicate that they may be very useful when employed in some kinds of films, in some kinds of learning tasks, in some viewing situations and with certain kinds of audiences. Motivation is a complex affair composed of many identifiable variables, as will be seen by the analysis given at the end of this paper.

A number of reasons have been suggested as to why built-in motivators have not proved effective, and they should be tested by further analytical experiments.

1. Motivators engendered by classroom situations could be so strong, for most students and other experimental subjects, as to override any built-in film motivators.

In classroom situations most pupils have learned that they are expected to pay close attention to instruction and put forth an effort to learn. This generalized school-drive may be augmented by film pre-tests. Even when pre-tests are not used, the well-known "Hawthorne Effect" could boost motivations. Experiments are needed in situations devoid of stimuli that evoke these school-drives. One is that of viewing ETV programs in the home where viewers can stop attending almost at will. Another would be that in which films are shown in school auditoriums on rainy days as a substitute for outdoor recreation. In such situations, films with built-in motivators may prove to be much more effective than alternate versions from which the motivators are eliminated.

2. Another motivator that could have an additional over-riding effect is the inherent interest in the subject matter of the presentation. It will be recalled that when students were asked to rate alternate versions of films for interest in the subject matter, no reliable differences were found in means of rating between versions, and both versions were rated at or above average in interest. But the effect that built-in motivators may have on learning from films rated low on inherent interest is yet to be determined.

The extent to which this factor contributed to the ineffectiveness of built-in motivators could be tested by varying the subject matter of a presentation from very dull to very lively. This might require a bit of doing, but there are known ways of presenting dull materials in an interesting fashion. A certain amount of pre-testing would be required to attain two versions that are sufficiently far apart in dullness. A program analyser may be useful in preparing these two versions. Each version would be presented in two editions. One would be embellished with motivators, and the other plain and simple. The prediction is that embellishments would add nothing to either liking or learning in the "interesting" version; but would add substantially to the "dull" version.

3. The ineffectiveness of the motivators in the cited experiments could be attributed in part to negative side effects which cancelled out the positive effects they may have contributed. One such side effect could be the distraction of attention away from relevant cues. But Neu's experiment indicates that attention-getters which were relevant to the contents to be learned were also ineffective. Even so, the learners

could have been so pre-occupied with the attention-getters that they didn't "get" the significant cues. One of the reasons for this result is that motivators, such as colored pictures or vocal emphasis, occur concomitantly with cue stimuli. The only device thus far tried that avoids this overlapping effect is printed questions or statements inserted into films. The problem is to find some pictorial or sound effect running throughout the film that does not distract attention from relevant cues. A musical background could be tried. We shall return to this problem in the section on cue discrimination.

The hypothesis that certain built-in motivators, such as color, humor, and live-action dialogue, distract attention from significant cues could be tested by inserting questions into the post-test on items that are totally irrelevant to what the film purports to teach. For example, in the color version of the Seasons film the boy actor has on a red sweater. Was this noticed and recalled? The setting was Christmas morning. What presents did the boy get, which ones did the girl get? The inclusion of such items would cover everything that was learned, both relevant and irrelevant.

According to information theory, the perceptual appartus can take in, decode, and store a limited amount of simultaneous input (Travers 1964). The extent to which learning of the irrelevant has crowded out or interfered with learning of the relevant would be reflected by a negative partial correlation between the number of relevant items correct and the number of irrelevant ones correct on the post-test, when intelligence and other contributing factors are held constant.

Harris (1962) compared the number of relevant and irrelevant test items learned by engineering students from a film on strength of materials with the numbers learned from a laboratory demonstration. From the test results of each presentation a "channel efficiency score" was computed by subtracting the number of irrelevant items learned from the number of relevant ones. He found this score to be higher on the film presentation than on the laboratory demonstration. A sample irrelevant item was the name of the manufacturer which was stamped on certain measurement instruments. Harris interpreted this result in terms of Broadbent's channel hypothesis. (See Travers 1964) Fewer irrelevancies were learned from the film than from the natural laboratory setting because the film minimized or eliminated many, but not all, of the irrelevant stimuli. This experiment illustrates the importance of including in a test items which measure both relevant and irrelevant information.

In addition to the over-riding effects of extrinsic and intrinsic motivators, and the possible negative effects of distraction, there may be audience variables that contribute to the lack of effectiveness of built-in motivators.

4. Individual differences in attitudes toward school could have been a factor. Students in the elementary and secondary school grades vary in their attitudes toward school, all the way from the "eager beavers" or "try-harders" to those whose attitudes are apathetic and negative. The latter have low school-drive and get the lowest marks, even if they are bright and capable of better work. For students who have low levels of motivation, motivators built into A-V presentations may be very effective. An experiment for testing this hypothesis would be relatively easy to design and conduct. In the types of experiment reviewed, attitudes toward school could be measured and controlled by analyses of covariance.

5. The age and grade of experimental subjects might have been a factor contributing to the negative results of previous experiments. The subjects in most of these experiments were either students in grades five to ten or youthful military trainees. It may be that devices and effects such as color, live-action dialogue, and humor appeal more to children in the lower grades. One of the reasons why younger children have not been used more in experiments on films is their low level of reading comprehension on verbal test items. But this difficulty can be overcome by the use of more non-verbal test items.

Other groups of experimental subjects for whom built-in motivators may be more effective are mentally retarded children and poor readers who are destined to drop out of school because of this disability. There are also bilingual children who have English language difficulties.

6. In addition to audience variables, there are utilization variables that may have an influence on the effectiveness of built-in attention-gainers and sustainers. Among these are external attention-directors which, as the experiments cited above indicate, have proved rather effective. Note has been made of the possibility that these procedures have the double effect of being attention-focusers and, at the same time, general motivators. The films used in the experiments in which external attention-directors have been employed were, for the most part, devoid of built-in motivators. This raises the question of what the result might be if they were employed with films which have color, live-action dialogue, or other embellishments. Would they be more or less effective? Or suppose they were employed with dull subject matter or with children whose school-drives are low. How effective would they be? Are there any theoretical reasons for supposing that they would be any more or less

effective when used in combination with various film and audience variables?

7. A test for retention (delayed recall) was used in only one of the experiments reviewed above. VanderMeer (1954) found that the color versions of two of the five films yielded significantly higher scores on a six weeks delayed recall test of verbal items than the corresponding B&W versions. In a later experiment, the color versions of these two films were rated significantly higher for liking than the B&W versions. There are theoretical reasons, and some experimental data, which indicate that pleasant, acceptable and satisfying learning experiences are better remembered than those which are dull, boring and unacceptable (McGeogh & Irion, 1952, p. 388-89). Years ago Holaday and Stoddard (1939) found that as much as 80 to 90% of the facts, both true and false, learned incidentally from theatrical films were recalled after intervals from one to three months. In their evaluation of the Army film, The Battle of Britain, which is a story-form documentary with musical background and other embellishments, Hovland, Lumsdaine & Sheffield (1949) found that about 50% of the factual items were retained after a period of nine weeks. These results indicate that a live-action dialogue story format of an instructional film could be predicted to have a substantial effect on amounts of knowledge retained. In this connection, mention might be made of the phenomenon of "reminiscence" which means that more is recalled later than immediately after learning. This phenomenon has been found to be greater for the recall of "substance" than of detailed verbal content.

This raises the question as to whether or not objective test items, covering the factual and conceptual information that the film purports to teach, measure all that is actually learned from a film. The essay type of examination may be more valid for measuring the "substance" of what was learned. After seeing a film the subjects could be asked to write down in essay form what they "think" they learned from it. Such an examination could be repeated after a period of six weeks or so.

PART II

REINFORCERS

1. Definitions of Reinforcement.

In A-V presentations employed for group instruction reinforcers are harder to identify and manipulate than they are in individualized group instruction such as in programmed textbooks. One reason is that responses to films and ETV programs are covert, unless provision is made for some form of audience participation. Such responses are largely self-reinforced or unconsciously reinforced by unidentifiable stimuli. A considerable amount of Pavlovian type of reinforcement may occur when unconditioned verbal cues are augmented by visual stimuli which already have the power to evoke the to-be-learned responses. Furthermore, learning factual materials from films is, in many respects, similar to paired associates learning where both the stimulus and response terms are given in the presentation, and unlike programmed verbal learning were the to-be-learned response is not revealed until after the learner has responded. In programmed learning, the sequence is present-test-tell; in A-V learning, it is present-tell, and test later. In the latter situation, reinforcement is that which increases the probability that the learner will remember and can reproduce what was told in the presentation.

Learning from A-V presentations involves at least two steps; one, correctly perceiving and grasping the to-be-learned material, and two, remembering it in the test situation. The first step is the familiar one of acquisition, and the second that of retention. It is always the latter that is tested by post-tests. Even when a post-test is given immediately after showing a film, some of the information that was "learned" may not be retained. The retention of what was initially learned depends on a number of factors. One is the extent to which the cues in the testing situation are similar to those in the learning situation; another is how well the initial learning was fixated - i.e. reinforced; and a third is the amount of retroactive interference produced by events occurring between learning and testing. A reinforcer can facilitate retention in two ways; it can fortify the initial learning, and it can serve as a mnemonic aid - i.e., elicit a response that will produce a stimulus that will evoke the correct answer. Visual images of pictorial parts of a film often serve this purpose.

The teaching effectiveness of an A-V presentation depends, theoretically at least, on the degree to which it is loaded with stimuli that have either one or both of these two kinds of reinforcing power. Such stimuli need not convey any additional information. They may be the kinds of devices and effects discussed in the first section of this paper. The problem is how to find them, how to build them into films so that they will not interfere with relevant cues, and how to manipulate them experimentally.

To say that a reinforcer is any stimulus that has been found to reinforce does not get us very far. We need to know their distinguishing characteristics, if they have any. But if any stimulus can become a reinforcer, then it has no externally apparent earmarks. They are characterized by the kinds of inner neural reactions that they elicit. Thorndike called them "confirming" or "ok-ing" reactions. There is physiological evidence, cited later in this paper, that electrical stimulation of certain brain structures has a reinforcing effect. To use another Throndikian expression, they may be called neural responses of satisfaction. They have the status of mediating mechanisms (or intervening variables) that stand between the stimuli that elicit them and their observable effect. They may be conscious or unconscious - i.e., unarticulate. It is relatively easy to find the kinds of stimuli and stimulus objects that learners say they "like or dislike" or find "interesting" or "boring". But the stimuli that elicit these overt responses may or may not also elicit covert neural responses of reinforcement. If all or most of them do, then we would expect that the better an A-V presentation is liked the better it will be learned and remembered.

Unfortunately, the experimental facts thus far obtained on the relation between liking and learning do not bear out this expectation. The correlations are close to zero. It will be recalled that when students were asked to rate alternate versions of a film for interest in the film itself and in its contents, few significant differences were found between versions embellished with interest appeals, and those without them. Also there were no reliable differences between mean scores on amounts learned from the embellished and simplified versions. However, VanderMeer found that color did add some slight amount to retention after a period of six weeks in the case of two films. These were the two which in a previous experiment were liked better in color than in black and white.

2. Correlations Between Liking and Learning.

The experimental studies cited above do not reveal the relation between individual variations on ratings and variations in amount learned because only means of ratings and means of amounts learned were reported. One experiment did show reported correlations between liking and learning. Ash (1949), in an experiment designed primarily to study the effects of massed vs. distributed showings of films, had his subjects rate each film on a seven-question inventory covering degrees of interest in the film and its pictorial quality. He used two films with groups of students in psychology classes, and two different ones with groups of Navy recruits. For the psychology students, the correlations between ratings and scores on information tests were positive but low and unreliable. For the recruits, the correlations ranged from positive to negative. Two positives of .43 and .54, significant at the .01 level, were obtained. It should be noted, however, that the information tests were given two weeks after the films were shown. This could be considered as one more scrap of evidence that liking is more positively related to the amounts remembered than to the amounts initially learned.

3. Liking and Learning Measured by Program Analysers.

Correlations between ratings on how well an entire film was liked and amounts learned or retained do not reveal possible relations between how each segment or part of a film was liked and the amounts learned from it. This brings us to a different type of study in which program analysers have been used to obtain ratings for liking and learning on each segment of a film or ETV program.

Program analysers (sometimes called Audience Response Recorders) have been used to study the relation between liking and learning by Twyford (1951, 1954), Merrill (1956) and Becker (1964). No less than fifteen kinds of machines or apparatus that have been used are listed by Twyford (1954). The essential feature of all of them is that a viewer can indicate his reactions to each sequence, segment, or seconds of running time by pushing a button, moving a toggle switch, setting a resistor dial, or striking a piano key. They vary in complexity from a single key that is pressed when a stimulus appears that is interesting, or liked, to mutiple keys to indicate degrees of interest or liking. Some machines record individual reactions on a polygraph, others summate the responses of a group of observers.

Amounts learned from each segment of a film or ETV program may be recorded in two ways, by adapting an analyser and by matching test items to film segments. The analyser used by Twyford consisted of a resistor dial on which there was a knob which could be set at positions marked "none", "little", "average", "much", "most", to indicate the amounts the observer thought he was learning. Twyford reports a fairly high correlation between learning profiles obtained by subjective ratings and corresponding ones obtained by testing. A correlation of .64 was obtained "when several corrections of the profile values were made" (page 245). The lack of an exact correspondence between rating and testing profiles would indicate that some subjects, if not all, may think they are learning when they are not, or rate their degree of learning low when tests show that it was high. This raises an interesting question. Is the amount that a subject actually learns better represented by what he thinks he has learned, or by gains on tests which may or may not measure all that was learned?

Correlation between liking and learning is obtained by matching liking profiles to learning ones. Just how the degrees of correspondence are quantified is not given in the literature. Twyford reports a negative correlation between rating for like-dislike and ratings for learning, but his 1954 article does not tell how these two profiles were obtained on the same films for the same subjects. (This, however, may be reported in his doctoral dissertation (1951) which this writer has not seen).

Merrill (1956), using Twyford's technique, had twenty adult female homemakers rate a kinescope of an ETV farm program both for liking and for learning. There was a liking session and a learning session but which came first and how much time elapsed between them was not reported. The ETV program was in two parts. The first part consisted of a talk and demonstration by a man on potato diseases; the second was a demonstration of sandwich-making by a woman. Forty farmers also saw the kinescope and rated it for liking only.

The liking-learning profiles obtained from the homemakers show that on the potato diseases section learning ratings are very high, almost at the top of the scale, while on the liking section they were lower, around the middle of the scale. On this section the correlation was .40. But on the sandwich-making section the two profiles were in fairly close correspondence and about two-thirds of the way up the scales. The correlation was .56. These results might be interpreted as follows. Homemakers thought they learned more about potato diseases than about making sandwiches because their initial knowledge about such diseases was less than about sandwiches. They rated the sandwich section higher for liking partly because they were familiar with it, partly because the sight of tasty sandwiches has secondary reinforcing power whereas potato diseases tend to evoke mild anxieties, and partly because they identified with the female demonstrator. This experiment illustrates two important points. First, overall correlations between liking and learning are ticky because they conceal too much; and second, the reasons why some parts of a presentation are liked better than others and why some teach more than others must be discovered.

Becker (1964) used gains from pre- to post-test as his measure of learning. He employed three different techniques for measuring affect. First, his subjects were instructed simply to press a button when an interesting sequence appeared; second, to rate it for degree of interest on a prepared sheet of paper; and third, electrodes were attached to record galvanic skin reactions. Two films were used, one about the Constitution of the United States, and one about the United Nations. Neither of these films contained any built-in devices for enhancing its appeal or interest.

Thirty fifth grade students were divided into three groups. One group got GSR and push button on one film and GSR and paper and pencil on the other; for a second group this order was reversed; and a third got only GSR on both films. Each subject viewed each film alone, and was given a factual content test just before and after viewing.

Profiles were plotted in four different ways: one by segments which transmitted information needed for learning the test items; another by shots or sequences; another by 30-sec. intervals; one by individual subjects. Profile reliabilities were satisfactorily high. Correlations between push button and paper and pencil responses were positive, .43 and .66 for the two films; but correlations between each of the two measures and GSRs were all negative, indicating that overt and covert responses measure different aspects of the situation. All correlations between gains in knowledge and the two measures of interest and GSRs were low.

As indicated above, all such correlations are tricky and may conceal the true relation between interest and learning. A more detailed analysis of results is needed. When pre- and post-tests are given it is possible to divide the items into four groups; correct-correct, incorrect-incorrect, incorrect-correct, and correct-incorrect. On the first two there is no change and hence no learning, the third indicates learning and the fourth unlearning (or measurement error). Each of these four groups of test items could be matched to points on the profiles of high and low interest, and high and low GSRs.

Becker (1964) did do something like this with his results. His test items were grouped in three categories; correct-correct, incorrect-correct, and incorrect on the post-test regardless of the result on the pre-test. For each category he counted up the number of film sequences (or shots) in which a GSR occurred and didn't occur, and the number of times the "interest" button was pushed, and the number of paper and pencil indicators of interest. Chi square treatment of these tabulations shows some slight but reliable differences, indicating greater frequencies of interest responses at the points where learning occurred than where it did not. But he also found that correct-correct items were positively related to his measures of interest. This result accounts, to some degree, for the over-all low correlations between interest and learning. Learners manifest interest in parts that are being learned, and to some extent in parts that are not learned.

4. The Need for Further Analysis of the Liking-Learning Problem.

(1) We need to know more about the kinds of visual and verbal stimuli that are pleasing or displeasing, interesting or dull, satisfying or annoying to students for whom A-V materials are intended. Becker classified the visuals in the two films that he used into 11 categories and calculated the percents of GSRs, push button responses, and high interest ratings that occurred when each was seen. He found no reliable

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difference between these categories in respect to measures of interest, but the number of "shots" in each was small, varying from 2 to 29. He did, however, find a relatively high number of GSRs to portrait drawings and shots showing the performers. We shall return to this point presently.

Travers (1964) summarized some of the studies on picture preferences and found that very young children prefer gaily colored pictures, and older ones and adults tend to prefer those that give an impression of reality - i.e., correspond to familiar objects in the environment. A number of radio and TV programs have been analyzed for audience liking. Sturmthal and Curtis (1944) found that action, expected action, contrasts, and excellent photography elicited "like" responses. while deprivational and anxiety-provoking scenes were disliked.

During World War II, Hovland, Lumsdaine and Sheffield (1949) used a polygraph recorder to measure the extent to which soldiers liked or disliked a series of films called The War. These records were supplemented with a questionnaire, administered after each showing designed to find out from each soldier why certain parts were liked better than others. Each film contained five episodes which the soldiers ranked in order from most to least interesting. The episode on training of amphibious troops received the highest average rating and the one on war production "back home", the lowest. A humorous cartoon episode was highest on the polygraph record and third on post-film rating. The polygraph records reflected reactions of immediate enjoyment, while the responses to the questionnaire were more evaluative. Among the shots most disliked were those that showed the narrator just talking; but when what he said was illustrated by real shots of action, interest was increased. Highly realistic action shots were in general the ones best liked.

In the ETV kinescope used by Merrill (1956) were two performers - a potato disease demonstrator and a sandwich maker. After each showing, his subjects were asked to indicate which of the two performances was liked better. Some of these ratings were made after the "liking" session, and some after the "learning" session. He found that both performers and performances were rated higher after liking than after learning sessions. But the question as to whether one performance was liked better than the other because its performer was liked better is not clear from his published results. But he was of the opinion that this was the case. It will be recalled that Becker found that the highest frequencies of GSRs occurred when shots of performers were seen.

The foregoing results would seem to indicate that if the "man on camera" does nothing but talk, interest lags; but if he performs a demonstration or engages in some other relevant activity, or if what he says is illustrated by other shots, interest tends to be maintained. This proposition should, of course, be tested by further experiments before it could be recommended with confidence to producers of films and ETV programs.

(2) We also need to know more about the relations between tensions, interest and learning. McGeogh and Irion (1952) have summarized some experiments which indicate that optimal amounts of certain kinds of muscular tensions under certain experimental conditions do in fact facilitate learning (p. 228 ff). One interpretation is that volleys of proprioceptive stimuli induced by muscular tensions send impulses which converge with those generated by cue stimuli and summate to reinforce responses. (Reinforcement is here used in the Pavlovian sense). Excitement

presumably has a similar effect. Hence a stimulus that is exciting, but not too much so, might facilitate learning. Muscular tension might also facilitate learning by producing what Guthrie has called "maintaining stimuli" which constitute a state of readiness for response. This state of readiness, expectancy, or vigilance may be measured in different ways. One, employed by Becker (1964), is by GSRs. His results are of interest because they show that frequencies of GSRs are negatively correlated with the frequencies of both push button and rating indicators of interest. He observed that covert GSRs evidently measure some aspects of the situation that are different from those measured by his indicators of interest.

What is the nature of these aspects? It could be that stimuli which elicit neural responses of readiness, expectancy, and vigilance have the properties of drives, while those that elicit manifestations of interest have the properties of reinforcers. According to S-R learning theory, one would expect learning to occur at places in a film where an "interest response" occurs concurrently with or immediately following a GSR. These places could be easily identified as those that convey the information for items that were incorrect on the pre-test and correct on the post-test. Becker inspected his graphs, not for this time-relation, but to find out whether or not a GSR followed a push-button response of "dislike" and/or a pencil rating of low interest. No such relationship was found. His raw data (if it still exists) should be further inspected for instances in which GSR-interest combinations are found in relation to where learning occurs, and where it does not occur.

One of the tabulations given by Becker (Table 4 p.286) contains data which indicate that the stimuli that elicit GSRs are not reinforcers, and that those evoking overt responses of interest are. He counted the frequencies of both of these kinds of responses at places on his two films where learning did and did not occur. A GSR was found in about 50% of each of these places, but an interest indicator was found in from 78% to 80% of the places where learning occurred, and in 20% to 34% of the places where it did not occur.

(3) Other areas for investigation are the presentations and activities that are learned but reported as being dull and disliked. We are reminded that educational philosophers from Herbart to Dewey have considered interest to be one of the essential conditions of learning. For Dewey, interest has a special meaning. It resides in instrumental acts that lead to a desired goal or end-in-view. It stands between where a learner is and where he aspires to be. He reminds us that the English word "interest" is derived from the Latin "inter-esse" to be between. Interest that contributes to learning is satisfaction that comes from progress toward desired goals. Perhaps one of the reasons for the low correlations between learning and interest as measured by program analyzers is that the learners had no end-in-view. They didn't feel that what they were learning was getting them anywhere or anything beyond the immediate situation. If push-button and other overt responses of likes or dislikes, interest or disinterest, mean nothing more than whether or not the stimuli are pleasing or annoying, one would not expect them to be correlated with learning except on occasions where they happen to act as reinforcers, as Becker's data indicate.

PART III

CUE IDENTIFIERS AND EMPHASIZERS

Devices built into A-V presentations to emphasize relevant cues, to aid the learner in identifying them, and to assist him in discriminating them from irrelevant ones usually contain no additional information. They are there to serve a particular purpose. If it is not served well, they may be omitted from future productions.

The purpose they serve is not only to direct the learner's attention to a relevant cue, but also to aid him in recognizing one when he sees or hears it. Pictures of objects have many aspects or dimensions, such as size, shape, color, and motion; sounds vary in intensity, pitch, and quality. Any one of these aspects of a picture or of the verbal content may be a crucial cue. Such cues are often so imbedded in a context of other stimuli that they are not immediately observed.

There are many ways by which they may be made more distinctive. One is by emphasis. This is illustrated by underlining critical words and phrases in printed materials, or by putting them in capital letters or in italics. Visual cues might be emphasized by printing them in color, or by camera closeups.

Relevant cues may be identified either by the narrator or by visual pointers, or both. If both, it is essential that the two be synchronized.

1. Color Cues.

Three experiments have been reported in which color was presumed to play a role in cue discrimination. They are VanderMeer's second experiment, and two experiments on ETV by Kanner and Rosenstein (1960 and 1961). VanderMeer classified his test items according to the sources of information in the films. The correct answers to one group of items were derived from the parts of the films in which color was judged to be an intrinsic cue; another group of items were covered in parts of the films where color was judged to lend emphasis to relevant cues; and a third group were covered by the footage in which color had only an aesthetic effect. Mean gains in each of these three groups of items were about the same for subjects who saw the black and white versions and those who saw the color versions. For items covered in the parts of the film where color was judged to be an important cue, the mean gains were slightly lower for groups who saw the color versions.

Kanner and Rosenstein (1960 and 1961) presented a number of lessons to military trainees over closed circuit TV in color in one classroom, and simultaneously in black and white in another classroom. In the first experiment there were eleven lessons on various types of electronic equipment, in some of which the instructors used color occasionally for cue discrimination; in the second, fifteen lessons on repairing the Nike Missile System, a more extensive use of color was made. In order to meet conditions of learning, the cues used in the test items should be similar to those in the learning situation. Some of the test cues were in color for the eleven lessons on electronic equipment.

The subjects in the first experiment were 368 enlisted trainees of whom 122 saw three of the eleven telecasts, 62 saw two and 184 saw only one. They were matched on the basis of electronic aptitude and general technical scores. The subjects in second experiment were 116 enlisted men, officers, and civilian personnel. Matched pairs of trainees and civilians were assigned to each of the two viewing sites. Appropriate information tests were given at each site immediately after viewing.

The two experiments, covering a total of twenty-six lessons taught to 484 subjects, yielded no significant differences in amounts learned between the color and black and white presentations. In fact, the mean scores on the colored test items used in the first experiment were slightly higher for groups who saw the black and white presentations. It was noted by the authors, however, that where the subjects viewing the black and white presentation saw shades of grey, the instructor named the colors. So it would appear that hearing the spoken word "red" was functionally equivalent to seeing a red color.

These negative results could be attributed to this verbal substitute for color plus the fact that achromatic cues of texture, shape and position are just as discriminable as colored ones. Also, since the entire presentation was in color, irrelevant as well as relevant cues were emphasized by color and thus had a negative effect on the amounts learned from the color presentations.

2. Visual Pointers and Animation.

These devices have been used mainly in training films. The classical reference experiment is one performed by Lumsdaine, Sulzer, and Kopstein (1961) who used alternate versions of a film to teach Air Force trainees how to read a micrometer. The two versions were identical in all but one respect. One version employed pop-in numerical labels and moving arrows to point to each of the various settings on the instrument as they were referred to by the narrator. Groups who saw this version scored significantly higher both on a performance test of micrometer reading, and on a verbal test of micrometer nomenclature. This superiority held up over a wide range of replications under different experimental conditions and over a considerable range of mental abilities and educational backgrounds of experimental subjects.

In a further experiment, using only the introductory section of the films, emphasis was put on teaching the names of the various parts of a micrometer. Two alternate techniques were employed. The first used only "pop-in" arrows indicating the parts of the instrument as they were named by the narrator with the entire instrument in view. In the other version each part was seen separately and the arrows were supplemented with printed verbal labels which faded in and out as the narrator mentioned the parts. The second technique yielded superior learning of all terms in the nomenclature, particularly for those that appeared less frequently in other portions of the film.

It may be noted that this second method, except for "dissolves" between parts, parallels a sound filmstrip. This raises the question of the value of moving vs. static cues. In a later experiment, however, Silverman (1958) found that for the acquisition of a skill, tested by performance, moving visual aids were reliably more effective than static ones; but for the acquisition of knowledge, tested by verbal tests, no reliable difference between these two types of presentations was found.

It may be that learning to read accurately the settings on a micrometer requires greater discrimination and is therefore more difficult than learning the names of its parts. Seeing arrows and labels pop-in and pop-out may aid not only in identifying and discriminating crucial cues but also in intensifying and emphasizing them.

3. The "Implosion" Technique.

This technique, invented by Sheffield, was based on his theory of "perceptual blue printing" as an aid to perceptual-motor learning (1961). In learning to assemble the parts of an instrument or machine from seeing it demonstrated the learner acquires a perceptual map or blue print of the parts and the order in which they are assembled. When such a blue print is fixed and remembered the learner can read off the correct sequence of responses. One type of blue print is derived from seeing disassembled parts fall rapidly into place in a fixed order without being moved by the hands of the demonstrator. This is called "implosion".

Sheffield, Margolius and Hoehn (1961) found this device to be very effective in teaching the assembly of the parts of a waste gate motor. The assembly was broken down into four main segments. Each segment was presented in two ways, one with and one without "implosion". The subjects who saw the "implosion" version gained about 20% more on the performance test than the subjects who saw the "no-implosion" version. The "implosion" technique was considered to be superior because it provided only the perceptual cues that were needed to complete the assembly - i.e., a perceptual blue print that was not cluttered up with irrelevant markings. It identified and clarified the critical cues and the order of their appearance.

A related experiment is reported by Aukes and Simon (1957). The task was teaching the sub-systems of the B-47 medium bomber to inexperienced Air Force trainees. It had been taught by a tape-recorded lecture accompanied by a standard set of visual displays. The experimenters substituted a new set of displays which showed how each part was consecutively added, without showing irrelevant stimuli. This display was substantially more effective than the standard one.

4. Cue Familiarization.

In A-V presentations that are new to a learner the identification of the relevant cues is especially difficult. In learning to assemble an unfamiliar instrument or machine, the parts present many different cues such as color, shape, size, and texture. A pre-film session devoted to familiarization with the critical cues should facilitate learning from the demonstration. This was demonstrated by an experiment of Wulff and Kraeling (1961) in which the task was learning to assemble the parts of an automobile ignition distributor. Two familiarization procedures were used. One was pre-film and one was built into the film. In the basic version of the film the parts were identified and emphasized by very close-up shots, and the entire assembly was shown in medium close-up shots. This version was varied by inserting more visual and auditory detail in the very close-up shots of the parts. As each part was shown the narrators called attention to significant features such as screw holes, slots in the ends of wires as arrows pointed to them. For the pre-film familiarization the parts were mounted on a masonite board and shown one at a time in a predetermined order, but not in the order in which they were to be assembled. As each part was shown the experimenter pointed out its essential features. After a first showing each subject was handed each of the parts and told to point to its important features. Errors were corrected.

Eleven subjects (all prison inmates ages 16 to 26) were assigned to each of the three procedures - basic film, pre-film, and in-film. Two performance test scores were given. One was for the number of errors made in selecting the parts that belonged to each sub-section and the time taken to make the selection; the other was the number of errors in assembly and time taken. On the first test, the in-film familiarization group made the fewest errors and took the least time, the pre-film group was next, and the basic film group was the poorest. The differences, however, were not very large. But when the two familiarization groups were combined, their mean error scores were significantly less than those of the basic film group.

The same general result was obtained from mean scores of assembly errors, the significant difference being .03 between the pre-film and the in-film groups. Differences in time to assemble were small and not reliable but in the same direction as those on errors.

Although these results favor in-film familiarization, it should be noted that the basic film version ran 22 minutes, the in-film familiarization version 30 minutes, and the total time for the pre-film training plus the running time of the basic film totaled 45 minutes. The basic film could have been run twice in about 45 minutes. This comparison was not made.

The hypothesis which this experiment was designed to test seems so plausible, both in theory and on the basis of prior experiments, that it should be repeated using a wider range and greater number of subjects and a variety of learning tasks.

It could be that the effectiveness of the devices used in the experiment of Lumsdaine, Sulzer, and Kopstein, and that of Sheffield, Margolius, and Hoehm, was due more to emphasis than discrimination because the irrelevant cues were shut out for the most part. However, the experiment of Wulff and Kraeling indicates that training in cue discrimination was somewhat effective. Further experiments are needed in which the emphasizing effect is separated from the cue-discriminating effect.

5. The Subjective Camera Angle.

This means that in learning a perceptual-motor skill from a film the model as it appears on screen should be seen from the same angle as it will be viewed in the test situation. The effectiveness of this camera angle was predicted from theoretical considerations by May (1946) and by Sheffield and Maccoby (1961). Roshal (1961) designed an experiment to test the effectiveness of the camera angle variable, in combinations with three other variables, motion vs. still picture, showing the hands of the demonstrator vs. no hands, and audience participation vs. no participation. Eight versions of a filmed demonstration of the tying of three knots - the bowline, the sheet bend, and the Spanish bowline - were prepared. In each version, the four factors of camera angles, motion, hands, and participation were systematically varied. The experimental population was 3,314 Naval trainees. After the tying of each of the three knots had been demonstrated in the film, the subjects were tested to see if they could successfully tie each knot within a two-minute time limit. Each performance was scored right or wrong. The effectiveness of each version of the film was measured by the proportion of subjects who tied the knot correctly within the time limit.

The results show that (1) the subjective camera angle proved superior to the 180-degree angle in all versions where this comparison was made, (2) motion is superior to still pictures in showing the successive steps in knot-tying, (3) the showing of hands in the static versions was less effective than the version that showed only the knots, (4) of the four versions that did not include the participation variable, the one that used the subjective camera angle, plus motion, plus hands yielded the highest over-all score for all three knots. This experiment demonstrates the importance of fixing attention on the crucial cues, which in the case of knot tying are the successive and orderly movements involved in changing the position of the ends of the rope, and the changes in the appearance of the knot at each successive stage.

In an earlier experiment, Gibson (1947) compared a film on teaching Position Firing to aviation trainees with an illustrated lecture and an illustrated manual. The superiority of the film was attributed to the fact that in the training situation the trainee viewed the significant

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aspects from the same point of view that they would in actual combat.

6. Other Devices.

A few experiments have been reported on the effectiveness of other visual aids: mock-ups, two-dimensional symbolic diagrams, and realistic pictorial charts (Swanson 1954); 3-D stereoscopic films (Cogswell 1952); mock-ups, cutaways and projected charts (Torkelson 1954). These devices on the whole have not proved very effective. Swanson, Lumsdaine, and Aukes (1956), however, did find that different kinds of visual aids were effective for different educational objectives.

7. Comments and Suggestions.

Although the foregoing experiments indicate that the devices and procedures employed as aids to cue identification and emphasis were on the whole rather successful, yet they leave unanswered a number of important questions which call for further research.

(1) Color is supposed to be an important aid for emphasizing and identifying relevant cues. Neal Miller (1957) observed: "Color should be an advantage if it is one of the most relevant cues or can be used to emphasize relevant cues; it should be a disadvantage if it distracts or complicates". It will be recalled that VanderMeer sorted his test items into three groups according to sections of the films where color was judged (a) to provide intrinsic (i.e. relevant) cues, (b) to serve to emphasize relevant cues, and (c) to have only an aesthetic effect. Mean gains in scores on each of these three groups were about the same for black and white as they were for color versions. A similar result is reported by Kanner and Rosenstein.

One explanation of these negative results is that when an entire film is presented in color both the relevant and irrelevant cues receive whatever emphasis color may give. It is as though an entire page of print were underlined or printed in italics. If a film were constructed so that all relevant cues appear in color and irrelevant ones in black and white, or vice versa, color might be much more effective, provided it is not used in a presentation in which all, or most, of the cues are relevant.

Even in instances where color itself is a relevant cue, and not merely an emphasizer, other achromatic cues such as shape, size, and texture may be equally effective. Furthermore, as Kanner and Rosenstein observed, naming a color by the narrator was functionally equivalent to seeing it.

The various dimensions of color, such as relevancy-irrelevancy, independent-redundant, are now under investigation at the University of Indiana by Black. For example, on a map, states and territories are identified by the shape of their boundaries. In this case color is irrelevant and redundant. But if a particular state always appears in the same color it could be identified by its color as well as by its shape. In this case color would be relevant but redundant.

(2) In regard to the techniques that have proved successful as aids to cue identification in perceptual-motor tasks, the question arises as to whether or not they would also be useful aids in other learning tasks such as the acquisition of facts and concepts and problem solving. The use of a pointer by teachers and lecturers for directing attention to points on a chart or chalkboard is common practice. Some modern slide projectors are equipped with a device for focusing a spot of light on some aspect of the projected display. The effectiveness of pop-in arrows, circles, or close-ups in instructional films could easily be tested by experiments.

(3) Another way in which learners may be aided to identify relevant cues is by instructions from the narrator. A narrator may speak about the visuals, i.e., talk about what is being shown, or he may speak without specific

reference to the visuals, assuming that they will illustrate or reinforce what is being said, or he may do both. Here is a variable that could be easily manipulated experimentally. For example, the sound track of a film could be varied so that in one version the narrator talks only about the film; in another, he makes no specific reference to it; in a third, he refers only to the relevant cues; and in a fourth, he refers to the irrelevant ones.

(4) Relevant cues may be identified in either of two ways, One is the use of arrows, labels, etc., the other is showing only the relevant cues pictorially and omitting the irrelevant ones. It will be recalled that Lumsdaine, Sulzer and Kopstein found, in teaching the names of the parts of a micrometer, that showing each one separately as it was named and labeled was more effective than showing the entire instrument and pointing to each part as it was named and labeled. Also Roshal found in teaching knot-tying that showing only the movements of ropes was better than showing them being tied by hands. The success of this procedure lies partly, if not wholly, in the fact that in the test situation the subjects were not required to discrimintate between relevant and irrelevant cues. But when to-be-learned responses are measured by multiple choice test items, the subjects must be able to discriminate between the right and wrong choices. So it might be predicted that in the case of instructional films, where discrimination is required in the test situation, showing only relevant cues during learning would be less effective than showing both relevant and irrelevant ones supplemented with identifying devices.

(5) Still another line of investigation is suggested by the experiment of Wulff and Kraeling on cue familiarization. Merely to be told that a strange looking object is a relevant cue, or to be shown on arrow pointing

to it, is not enough to make it an effective cue for learning. Its relevance to learning depends on how it is perceived and understood. To the untrained eye an automobile ignition distributor, or any other complex piece of machinery is, as Woodworth once said, "a big blooming confusion". The trained mechanic, who is thoroughly familiar with all parts and subparts and how they are interrelated, has little difficulty in spotting defects such as pitted breaker points. As noted at the ends of the preceding sections on motivators and reinforcers, the optimum combinations of pictorial and auditory variables in A-V presentation will depend on their interactions with audience variables. Just as the effectiveness of built-in motivators and reinforcers depends on those previously acquired by the learners, so will the effectiveness of relevant cues depend on acquired cues. Carpenter has noted that "the effects of film instruction, within certain limits, depend more upon the characteristics of the perceivers, individuals and audiences, than upon the elemental variables within the films themselves".

The most reliable predictors of the amount that an individual will learn from a single A-V presentation might be obtained from an inventory of his acquired motivators, reinforcers, and previous knowledge of the content, which is composed in large part by acquired cues. Lumsdaine (1958) found that students who had received previous instruction on the topic of osmosis gained significantly more knowledge from a film on osmosis than did an uninstructed group, when gains were computed as percentages of room for improvement - i.e. gains relative to the amounts of material not initially known. This result could be, as Lumsdaine pointed out, attributed to other factors in addition to the previously learned cues.

One measure of the cue value of a stimulus is the perceptual response which it elicits. Familiarity with the relevant pictorial cues in a film could be measured by presenting learners with still pictures made from frames that contain them. The students would be instructed to tell what they mean, or what they represent. Scores on such a pre-test could then be correlated with scores of film post-tests.

(6) The problem of measuring the effectiveness of an experimental variable apart from its interactions with other variables again rears its ugly head. A device for identifying or for emphasizing relevant cues in an A-V presentation may do its job very well and have little or no effect on the scores because such scores reflect the combined effects of several variables. For example, cue identifiers may facilitate immediate learning but have no effect on immediate recall or later retention. So negative results, as reflected by scores on post-tests, or on gains from pre- to post-tests, do not prove that the cue identifiers failed to do their job. What is needed is a technique of finding out the extent to which attention was focused on relevant cues during the presentation.

An instrument for recording eye movements when looking at a TV screen, developed and utilized in preliminary experiments by Guba and Wolf (1958), may prove useful for measuring the effectiveness of devices for focusing attention on relevant cues. This apparatus has a number of advantages over the standard one by which light reflected from the cornea is photographed. It measures more dimensions of eye-movement, and the eye-movement of a subject can be monitored and recorded in the control room.

PART IV

SIMPLIFICATIONS

A-V presentations may be simplified for the sake of economy or to improving their effectiveness or both. This can be done in either of two ways. One is by eliminating from a film or ETV program all materials which by experiment are found to contribute little or nothing to the amounts learned and retained. Another is to substitute simpler and equally effective modes of presentation. As to simplifications of film content, experiments have been reported on the value of introductory and review sections, on the number of examples and illustrations in training films, on the elimination of certain optical devices and effects, and on improving the "readibility" of the commentary. As to alternate methods of presentation experiments have been reported on films vs. filographs, films vs. filmstrips, and films vs. illustrated lectures.

1. The Effectiveness of Introductory and Review Sections.

Lathrop (1949) found introductory sequences in 130 instructional films and classified them according to objectives and visuals employed. He selected three which seemed to be typical and prepared alternate versions from which these introductory sequences were eliminated. They were relatively short, running from 25 seconds to 60 seconds which was 4% to 10% of their total running times. In all three introductions, one of the purposes was to "set the stage"; in two, it was also to stress the importance of the content; and in one, the problem of the film was posed. The visuals employed were live action, animation and mock-up models.

The experimental subjects were 500 ninth grade students who were divided into three groups, one for each version of each film, plus a control group which saw neither version. The three groups were rotated among the three films so that each group was the control for one film, saw a modified version of another, and the full version of still another. All received the same post-tests composed of items on what each film purported to teach. The results show that both film versions produced higher mean scores than no film; but there were no reliable differences between the means of scores for the two alternate versions. Thus it appears that these short introductory sequences contributed nothing to amounts learned.

Northford (1949) did a similar experiment on review sections. Three science films were selected from 87 that had been studied from the standpoint of the length, objectives, and techniques of the review sections. The objectives were recapitulation, application, importance, challenge, and new information. The techniques were music, animation, live-action, and new scenes. The time spent on review in the three selected films ran from 10 to 13% of the total, with an average time of one minute and ten seconds. Northford used the same experimental design as Lathrop, and the subjects were ninth grade students in science courses. The results were about the same as Lathrop's. There were no reliable differences between mean scores on the two film versions.

These two experiments indicate that short introductory or review sections add little or nothing to the teaching effectiveness of instructional films. But this does not mean that all introductions and reviews are worthless. Northford observed that the three science films that he used were so packed with information that it required a 60-item test to cover the material presented in a ten-minute film. Only about one third of these items was learned from a single showing. It is unlikely that a short summary would have much effect on this low level of learning.

Suppose, however, that the introductory and review sections were longer. Hovland, Lumsdaine and Sheffield (1949) found in an experiment on map reading that a fifteen to twenty minute introduction to a film and review exercises of the same length added very little to amounts learned from a 43-minute film.

The results stand in contrast to those reported at the end of Part I of this paper where it was found that pre-film procedures for directing and focusing attention on relevant parts of film were on the whole rather successful.

Miller and Levine (1952) compared a review section at the end of a film (massed review) with the same amount of review materials interspersed at the end of each sub-section (special review). The film used was Ohms Law which contains four distinct sections, Each section was marked with a sub-title. They found that "massed review" was significantly superior to both no review and to "spaced" review; but spaced and no review were about the same. This superiority could be attributed, in some part at least, to the factor of recency. The massed review at the end of the film was closer in time to the criterion test.

This experiment was replicated later by Miller, Levine and Sternberg (1956) using a film which presumably had a higher interest value than Ohms Law. It was a defense film called Pattern For Survival. The subjects were twenty-three classes of high school students assigned at random by class to each of three versions - no review, spaced review, and massed review. The highest mean score was obtained on the massed review versions, the next highest on the spaced review version, and the poorest on the no review. The differences were quite reliable. However, when this experiment was replicated by Miller and Klier (1956), employing two kinds of spaced review, active and passive, the active-spaced was about equal to the passive-massed. This was attributed to the fact that in active review errors were checked by knowledge of results. In this experiment, however, the difference in running time between the versions that provided for active practice and the other versions was not reported.

In the above experiments, the superiority of review, whether spaced or massed, over no review stands in contrast with the results obtained by Northford and by Hovland, Lumsdaine and Sheffield, who found that review sections, either in the film or given by the experimenter, contributed almost nothing to the amounts learned.

2. Repetitions and Redundancies.

Instructional films may carry two or more illustrations of important concepts, and training films may present two or more demonstrations.

The multiplication of demonstrations and illustrations adds to the running time of a film. So the difficult, and almost insoluable, problem arises as to whether the increased learning (if any) is worth the extra time. Jaspen (1950) found that Naval trainees who saw four demonstrations of a breech block assembly in one version of a film had a median assembly-test time of 102 seconds, while the group who saw a comparable version containing only two demonstrations had a median time score of 150 seconds, a difference of 50%. But the running time of the four-demonstration version was 50% longer than that of the two-demonstration version.

McGuire (1961) varied the length of a film designed to demonstrate pursuit-rotor tracking. A five minute version contained two repetitions, and a ten minute version contained four. Each was presented with and without narration. Twelve instructional items on "how to do it" were depicted in the film, and narrated in the narration version. The criterion test was the mean number of seconds on target during the first five minutes of test trials. The mean scores of the subjects who got two repetitions were about the same as the scores for those who got four. This was true for both the silent and narrated versions, But as McGuire pointed out, the amount of over-learning from the four demonstrations might have resulted in higher retention scores after the elapse of a period of time.

In the study on micrometer reading by Lumsdaine, Sulzer, and Kopstein (1961), there were three examples or illustrations in the original film. In other versions, these were varied up to ten by combinations of films and film strips. They found that adding three more examples to the three in the film doubled the amount of skill gained; and ten examples were somewhat better than six or seven. The gains were greater on the most difficult aspects of the learning task; and the more intelligent subjects profited more from them than did the less intelligent.

In the above experiments the repeated examples were identical. In order to cover in the teaching situation as many stimulus variations as are apt to occur in the test situation, variations in examples and demonstrations would seem profitable. Kanner and McClure (1956) compared the effectiveness of four examples seen twice with eight different ones in teaching the reading of a micrometer. In the first experiment two groups were used, an advanced mathematical group and a regular group. Varying the examples added nothing to mean scores of the regular group but did add a small but reliable increment to delayed test scores of the advanced group. In a second experiment, however, the varied examples gave no better results than the identical ones for either group, on both immediate and delayed recall tests.

Rimland (1955) compared the effectiveness of two identical demonstrations of knot-tying, with two that were varied, and found that the identical ones were superior. But knot-tying and micrometer reading are two different kind of skills. One requires that the demonstration be imitated, while the other requires that it be generalized.

3. Opticals for Marking Transitions.

Transitions from scene to scene in films may be marked in several ways. One is by the use of optical effects, such as "dissolves", "fades" and "wipes", which give the presentation an appearance of smooth continuity. They are, in fact, embellishments inserted by film editors. Mercer (1952) sent a questionnaire to several producers of instructional films asking for the extent to which these devices were employed and why they were used. The replies indicated that they are used to smooth out a film and to avoid an appearance of "jerkiness" produced by cuts. It was assumed that learners would, of course, understand why they are used. But do they?

Mercer (1952) tested this assumption on twenty-four Air Force trainees using a film which contains 173 cuts and 62 optical transitions. A program analyser was used. Subjects were instructed to hold down a key until a cut appeared and then release it, and to press another key if some interpolated optical appeared between scenes. In the first quarter of the film about 40% of the opticals were recognized, but this figure rose 63% in the last quarter. When questioned later about the purposes of transitional opticals, the subjects gave a wide variety of answers indicating that their functions were not very well understood.

The next question was: do such opticals add, detract, or have no effect on learning from a film? Mercer (1952) selected two films which had many opticals in the original versions. He prepared two modified versions of each. One had no opticals, only cuts; the other had an optical between each sequence. Two groups of military trainees were used. One group was given previous instruction in "film literacy" including the meaning and use of opticals. The other group did not get this instruction. The instructed group was split into three sections and assigned to each of the three versions of each film. The uninstructed group was also split and assigned to each of the versions. On an information test there were no reliable differences in mean scores either between film versions, or between instructed and uninstructed groups. The instructed group did score higher on a special "film literacy" test. Mercer concluded that it was the cues given in the narration plus the cuts in the picture that were the determining factors in recognizing a transition.

Following up this observation, McIntyre (1954) substituted printed titles for transitional optical effects in one modified version of a film; and in another version, blank spaces were left. Matched groups of 428 Army trainees were assigned to the original and to each of the two modified versions. Amounts learned were measured with an information post-test. The mean score of the group that saw the "titled" version was significantly higher than that of the group that saw the original with opticals, and also higher than that of the group seeing the version with blanks. But there was no reliable difference between "titles" and "blanks". This result suggests that opticals tend to confuse rather than clarify the points in a film where transitions occur.

These experiments further illustrate the point that irrelevant visuals employed in the interest of smoothness and film artistry may serve to inhibit rather than facilitate learning.

4. Simplifications of the Narration.

The verbal content of A-V presentations is composed of a large number of elements some of which are inherent in the script and others are found in the way it is delivered orally. Many of these elements are identifiable and can be manipulated experimentally, either individually or in combinations. The problem is to find combinations in the script that maximize reading comprehension, on which learning from spoken presentations largely depends. There is no single pattern that is optimal for all learners and for all learning tasks. We know that reading comprehension depends on age, I.Q. and other factors which have been explored in the numerous studies on reading. (For a recent summary see Klare 1963). Listening comprehension is linked to reading ability with common factors such as vocabulary. These common factors have been found to yield fairly high positive correlations between these two abilities (Dale and Chall 1948). We know that general verbal ability is a crucial factor in learning abilities, as evidenced by the high correlations between measures of this ability and academic success. Listening comprehension can be predicted from the readability of the script to the extent that each is correlated with the factors involved in general verbal ability.

The relationship between amounts learned from films and measured readability of the narration has been investigated (Allen 1952, Moldstad 1955 and Gladstone 1958). Readability in both of these studies was measured by the Dale-Chall (1948) and the Flesch (1949) formulas.[1] Although these two formulas vary somewhat in respect to component variables such as length of words, frequency of hard words and human interest words, they give essentially the same results.

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[1] Klare (1963) reports that no-less than 31 formulas for readability were published between 1923 and 1959.

Using the Flesch formula which measured both ease of reading and human interest, Allen (1952) prepared two fifth grade and two seventh grade versions of the narration on each of two instructional films. One was an ease of reading version and the other an human interest version which measures the degree of interest or dullness of the narration. The subjects were 22 classes of sixth grade students in four schools. Two weeks before the films were shown a pre-test was given on the information contained in the two films. Students were assigned at random to each of the four film treatments. A post-test was administered immediately after each showing.

These sixth grade pupils learned significantly more from the fifth grade level of reading ease, than from the seventh grade level. This was true for both films. No significant difference were found between levels of human interest. When the results were analysed in terms of elements in Flesch formula, it was found that the shorter the sentences the greater the gains, and the easier the reading score the greater the gain. It would appear from this study that a commentary with readability at least one grade level below that of the pupils is superior to one at a higher grade level. But the reliability with which oral comprehension can be predicted from readability remains undertermined.

Gladstone (1958) did a similar experiment using a 20-minute documentary film on What is China? The original commentary was re-written to increase its factual content. Two versions were prepared using both the Flesch and the Dale-Chall formulas. One was at about the fourth and fifth grade level and the other at the ninth and tenth. The subjects were 113 seventh and eighth grade pupils. Two intact classes, one seventh and one eighth grade, were assigned to the easy version, and three to the difficult one. Two forms of a 28-item information test were prepared; one form was given just before and the other just after each showing. The classes that saw the easy version had higher mean scores than the ones who saw the hard version, but the difference was not significant. This could have been due in some part to the fact that, for administrative reasons, pupils could not be assigned at random to each version or on a matched basis.

One way around this difficulty was to split each commentary in two so that there would be an easy and hard version of each half. The test items also were divided accordingly. Thus each pupil was exposed to an easy and to a hard commentary. The classes were rotated so that some saw the easy first half, and others the hard first half. When mean gains were compared by halves, there was no significant difference on the first half, but the easy version of the second half showed a gain of 33% over the hard version, after differences in reading comprehension had been controlled by covariance. This difference was partially explained by the fact that the gap between the easy and hard versions was much less on the first half than on the second.

These three studies (Allen and Gladstone and Moldstad) leave unanswered two important questions. First, which of the elements in the readability formulas have the greatest effect on learning from films - length of sentences, length of words, vocabulary, or sentence structure? Second, how accurately can oral comprehension, on which learning from films immediately depends, be predicted from measures of readability? The answer depends, of course, on variables in the delivery that are not in the script.

Another way in which a script may be simplified is by cutting out all redundancies, reducing it to a kind of telegraphic writing. This possibility was investigated by Fletcher (1955) who employed two methods of condensing a script. First, script writers condensed a script by 8%. Second, the results of a pre-film analysis reduced the same script by 24%. Comparable groups of Naval recruits were assigned to the original version, the version shortened by 8%, and to the one shortened by 24%. It was found that the mean scores on a 50-item information test of the groups who heard the shorter versions were about as high as those of the group who saw the longer one. If each version contained all the information needed to answer the test items correctly, and if the running time of the film was the same for each version, then the difference between versions was due to the rate at which the narration was delivered. Another variable is the amount of information conveyed by the narration in relation to that amount conveyed by the visuals.

Zuckerman (1949) varied the commentary of a training film on knot-tying in respect to (a) levels of verbalization, including the kinds and numbers of words per minute of running time, (b) personal reference and grammatical mood, and (c) time relations between the verbal and pictorial elements.

Six versions of a sound track, in which combinations of some of these variables were included, and one version with no sound track, were prepared. The subjects were 1787 Naval recruits who were assigned at random to each of the seven versions. The pre-test showed that none of these subjects could tie these knots before seeing the films. The post-test in each case was the ability to tie each knot in the alloted time. The results showed that a medium level of verbalization (111-141 words per minute), in which the main movements were described and hints or cues were given, was significantly better than either the lower level (71-103 words per minute) or the higher one (155 to 185 words per minute). Variations in personal references, such as "here's how I do it", or, "you do this", or, "it is done this way" appeared to have little effect on the scores. However, it was found that the imperative mood, such as "Form a loop like this", was somewhat more effective on Naval recruits. When the verbals preceded the visuals, the results were slightly better than when the visual preceded the verbals. This study would seem to indicate that learning may be increased by reducing the verbalization down to an optimum level. Below this level, learning is decreased.

Jaspen (1950) varied the average number of words per running minute of a film designed to teach Naval trainees how to assemble the breech-block of an anti- aircraft gun. The average number of words per minute of film was varied from 142, 97, 74, to 45 in four versions. The criterion was the time required for correct assembly. The medium rate of 97 words per minute was the best, the rate of 45 was the poorest, and the rates of 142 and 74 in between. This suggests that the relation between words per minute in training films is curvilinear, in the shape of an inverted U. This result is difficult to evaluate without knowing more about such factors as kinds and lengths of words used, and the amounts of information conveyed by them in relation to amounts conveyed by merely watching the filmed demonstration. Furthermore, when the number of words are counted there may be considerable variation in word density at different sections of the film. The rate of verbalization was controlled not by how fast or slowly the sentences were uttered, but by the periods of silence between phrases or sentences.

A further illustration of how an A-V presentation may be simplified is found in an experiment by Vincent, Ash, and Greenhill (1949). Four versions of an instructional film on frontal weather were prepared. The running time of the film, and the amount of information contained were varied. The four versions were: (1) long (30 minutes) and heavy (224 verbal facts), (2) long and light (112 facts), (3) short (14 minutes) and heavy (112 facts), and (4) short and light (56 facts). The subjects were high school seniors, college students, and Air Force basic trainees. Comparable groups from each of these four catagories were assigned to each of the four versions. All subjects got a 136-item multiple choice test immediately after each showing and again some time later for testing retention. The differences on this test between the mean scores of the groups who saw the various versions were not reliably different, even though the subjects who saw the light version did not have the opportunity to learn as many facts as those who saw the heavy versions. This experiment would seem to suggest that an A-V presentation could be simplified down to a level that is within the grasp and retention of the learners for which it is intended without loss in effectiveness. However, before jumping to such a conclusion, there are two things about this experiment that could have influenced the results. One, the readability of all four of the commentaries was set at the seventh or eighth grade level, and two, the content of a film on meteorology was rather dull and lacking in intrinsic interest for many of the subjects.

5. Films, Filmographs and Filmstrips.

A filmograph is a simplified version of a motion picture film. It is produced by running a movie camera over an orderly series of still frames taken from a film, or over the story board from which the movie was produced. It has the advantage of presenting the element of motion and at the same time eliminating most of the irrelevant or redundant footage. Also, it is much less expensive to produce.

Two or three experiments have been reported in which amounts learned from a filmograph have been compared with amounts learned from the film on which it was based. Lumsdaine (1958, Ch2) reported an experimental comparison of the finished color version of the film, Seasons, with a kind of filmograph called a preliminary "pencil-test running reel", which had been made by running a motion picture camera over a series of rough sketches that constituted the preliminary story board. This crude pencil-test version was never intended to be a teaching instrument. It was merely one step in the process of production. The photographic quality was poor, and the visuals differed markedly from those in the finished version, unlike a filmograph in which the visuals are identical with those in the finished film.

Four classes of fifth grade pupils were divided at random into halves, one half seeing the crude version and the other half the finished one. A 91-item information test was administered after each showing. The mean number of test items correct was almost exactly the same for the two groups.

In order to discover whether or not there might have been some parts in which one version was superior to the other, the test items covering the entire content were subdivided into ten groups, each on a different area of facts and explanations. This area-by-area comparison showed no reliable differences.

This crude version represents the maximum degree to which the finished version could have been simplified. The three qualities eliminated were color, live-action dialogue, and artistic finish. The cost was about one tenth of that of the finished product.

Carpenter and his group at Penn State (1954) prepared a filmograph from a sound motion picture on Riot Control. This film contains a number of mob scenes which were considered irrelevant to its main purpose and which could create confusion in the minds of the viewers. Two filmograph versions were prepared. One was based on frames taken from the original version; the other was shorter and based largely on stock photographs which were substituted for the complex mob scenes. The subjects were military trainees. Pre- and post-film tests were used to measure gains in factual knowledge and changes in attitude toward the activities depicted in the film. All groups showed significant gains in knowledge. The knowledge gained from the original version was slightly greater than that from the first filmograph. Gains from each of the filmographs were about the same. The results are similar to those obtained by Lumsdaine. Simplified versions are about as effective as more complex ones. All three versions had about the same effect on developing attitudes.

McBeath compared a silent captioned filmstrip, a sound captioned filmstrip, a sound filmstrip without captions, and a filmograph for relative effectiveness in teaching the facts and concepts contained in a sixth grade social science lesson. The sound filmstrip and the filmograph contained the same narration. The filmograph was more polished and used more A-V embellishments. The subjects were twenty sixth grade classes (n-558). Within each class the pupils were matched in respect to age, sex, I.Q., and occupation of father, and assigned to each of the four versions of the presentation. All were pre- and post-tested with a 60-item test on facts and concepts. A retention test was given after a period of three weeks. No reliable differences were found either on the immediate post-test or on the retention test. On the test of immediate recall the highest mean score was made by boys who saw the captioned narrated filmstrip, and the lowest by girls who saw the filmograph. These sex differences, however, were not very great. This experiment contributes one more bit of evidence that simplified presentations are, for some purpose, as effective as more complex ones.

6. Films vs. Filmstrips.

Earlier studies in which films have been compared with filmstrips, presenting the same content, are reviewed by Hoban and VanOrmer (1951). The studies by James (1924), McClusky and McClusky (1924), Brown (1928), Carson (1947), Vernon (1946), Hovland, Lumsdaine and Sheffield (1949), and Gibson (1947), all indicate that filmstrips are about effective as films, and in some cases more so, for teaching facts and concepts.

The results of these studies are difficult to evaluate, as Hoban and VanOrmer have pointed out. In order to compare the relative effectiveness of simplified static presentations with more complex presentations of the same material in motion, it is necessary to control such factors as: (a) the amount of time devoted to the presentation of each item of information, or each concept to be grasped; (b) the amounts and kinds of verbal "explanations" and comments employed; (c) the sharpness of the transition between sequences in films and frames in filmstrips; (d) the amount of the content in which motion is an essential cue, or relevant to the facts and concepts presented. As Silverman (1958), Roshall (1961), and Gibson (1947) have observed, moving presentations are superior to static ones for teaching facts and concepts about changing events and variations in relations between objects. But as Lumsdaine and May (1965) have indicated, it is possible to depict motion statically and symbolically with "swish" lines and other visual devices.

In their experiment on map reading, Hovland, Lumsdaine and Sheffield (1949) found that the filmstrip was better than the film for teaching men how to measure distances on a map, but that the film was superior for teaching the meaning of the spaces between contour lines. They attribute this to the fact "that in the film the object being photographed can remain still while the angle from which it is viewed can be progressively altered" (p.127). This observation is generalized in the statement: "that where familarity with three-dimentional space relationships is important in learning the material, movies have an inherent advantage that cannot be equaled by filmstrips" (p.129).

One method of testing the relative effectiveness of films and the filmstrips based on them is to discover how much of the learning from the film can be predicted from the amounts learned from the filmstrip. The kinds of facts and concepts not gained from the strip could then be attributed to the element of motion. Zuckerman (1954) prepared a 250-frame filmstrip in black and white from the story board sketches on which a 25-minute color film on the Flight Capabilities of the F86-A Bomber was based. One group (N-45) of jet pilot trainees saw the filmstrip and a comparable group (N-45) saw the color film. A 26-item information test was given before and after viewing. The results were tabulated by showing the percents of each group who got each item correct both before and after viewing. An item-by-item correlation of absolute gains was .71; but when gains were adjusted for differences on the pre-test, the correlation jumped to .94. The item-by-item tabulation, however, shows that the absolute gains from the film exceed those from the strip in 14 out of 26 items. Most of these differences were rather small, but three or four were quite substantial even after adjustments were made in differences in pre-test percentages. Without an examination of the items and the contents of the two presentations it is not possible to tell whether or not these were the items for which motion was an essential cue.

7. Comments and Suggestions.

(1) The effectiveness of built-in introductions to films.

In the only experiment that has been reported on this topic - that of Lathrop - it was found that short introductory sections added nothing to amounts learned. This stands in contrast with results reported earlier in which pre-film instructions and other procedures were found to be useful aids as attention-directors, and cue familiarizers and identifiers. On the basis of the few available facts, one might be tempted to recommend that most films could be shortened and simplified by omitting introductory sequences. Such a recommendation, however, would be premature. Some kinds of preparatory materials may be useful in some kinds of films, and for some kinds of purposes. The introductions found by Lathrop in some 130 current instructional films may be classified as orienters, motivators, attention-directors, cue familiarizers and identifiers. An introduction could perform any one or more of these functions which are known to be important factors in learning from A-V presentations. Lathrop counted 11 functions and 12 filmic techniques. To vary these systematically over several different kinds of films, used for different educational purposes, would be a long, tedious and almost impossible task. The use of the functional classification suggested above could simplify the problem. We know already, as indicated in the first section of this paper, that built-in motivators are not as effective in classroom situations as pre-film procedures.

(2) The effectiveness of built-in review sections.

How may the conflicting results of previous experiments be reconciled? Were they dissimilar because of differences in content or in learning tasks? There are reasons for believing that passive reviews that convey no new information should aid retention because of overlearning. If so, then the best tests for the effectiveness of such reviews would be retention tests.

Northford (1949) asked several psychologists and educators to name the functions that reviews should perform. They mentioned: (a) topical outline of the film, (b) recapitulation of the main points, (c) stress importance to the viewer personally, (d) challenging note, (e) example of application of the knowledge gained, (f) relate film to new and further information. He found that these functions had been implemented and presented by no less than 8 different filmic techniques in the 87 films reviewed. The psychologists and educators who suggested these functions presumably had reasons for thinking they could be effective, but unfortunately they are not reported. Here again, a functional classification based on established principles of learning and retention is needed.

(3) The effectiveness of multiplying the number of demonstrations, examples or illustrations.

The number of demonstrations interact with other variables. One is active practice at the end of each demonstration. This variable will be discussed at length in the working paper on Student Response. Another variable is the running time of the film. Experiments of Jaspen (1950) and of Lumsdaine, Sulzer and Kopstein (1961) suggest that gains in learning from increased numbers of demonstrations are roughly proportional to increases in running time, up to a certain point. But no general principle has been found from which this point could be predicted.

From the standpoint of economy of production the question arises as to whether a short, simplified version of a film that is shown twice or more, yields as good results as a longer and more complex production that runs the same amount of time. It will be recalled that May and Lumsdaine (1958) found that two showings of the original film on Heart and Circulation of the Blood took about the same time and gave about the same results as a more complex version. A similar result was obtained by Weis and Fine (1955). It will be recalled that McGuire found that a long film with four repetitions was no more effective than two showings of a short version containing only two of the repetitions. But McTavish (1949) found that there is a "saturation" point beyond two showings where "the law of diminishing returns" sets in. But here again there is no principle or knowledge from which this saturation point could be predicted. Why is it that after two showings, pupils have learned about all that they can from a film? An examination of the nature of the unlearned parts may be revealing. It could be that after two showings a negative drive of boredom generates a loss of motivation.

(4) Simplifying the narration.

The experiments of Gladstone (1958) and Allen (1952) indicate that narrations with a readability score of about one grade below that of the students produced better learning from instructional films than readability scores at the next higher grade level. This difference could be due either to the fact that these formulas were standardized on reading and not on listening, or to the higher abilities of the students on which they were standardized. While the two experiments may provide producers of instructional films with a useful rule of thumb, this rule may not always produce optimum results. More systematic analyses of the relative effectiveness of the component parts of these formulas should be made.

There are no doubt many significant differences between reading and oral comprehension that have not been investigated. In oral comprehension the rate of presentation is controlled by the speaker. It has been found by Diehl, White and Burke (1957) that the optimum rate when the listener is not looking at a screen is about 160 words per minute, and about 100 words per minute when the listener is looking at a motion picture, as found by Zuckerman (1949) and Jaspen (1950). Travers (1964) suggests that this result fits well the model of information transmission which postulates that "the rate at which information can be transmitted effectively to the human receiver is limited and cannot be increased by using more than one sensory channel or more than one source of information". (Page 2.77).

Jaspen's results show that the crucial factor was not the speed at which the words were uttered, because this was the same on each of his versions. The number of words per minute of film was controlled by the length of pauses between sentences. Because the learning task was perceptual-motor, the amounts learned per minute of film time were not measured. In an instructional film where the test items can be matched to each of the successive minutes of film time, the amounts learned in each minute could be measured. Travers reports that this problem is now being investigated at the University of Utah (1964 p.2.58).

Two facts have been established; narration is better than silent projection with printed titles, and there is an optimum level of verbalization.

(5) Simplified alternate presentations.

The few experiments in which the relative effectiveness of films vs. filmographs, and filmographs vs. captioned sound filmstrips has been compared all point to the conclusions that, for some types of materials used for some purposes, the simpler presentations are about as good as the more complex ones. No dependable generalizations can be made from these experiments as to the kinds of materials that should be produced in simplified forms. But the experiments reviewed in Part I of this paper and those on the simplification of narrations suggest, as May and Lumsdaine have pointed out, that in producing as instructional film "relatively more of the

available funds might be devoted to working out a teachable plan, good visualization devices, and effective narration, and relatively less to perfecting the photographic and artistic qualities of the product". (p.24).

This raises, however, the important question as to whether the consumers of A-V products - teachers, A-V coordinators, film librarians - prefer the simpler to the more complex presentations in cases where they have been experimentally demonstrated to be equally effective. For example, all experiments thus far show that black and white versions of instructional films and ETV programs are as effective as color versions. Suppose that these alternate versions were made equally available to a sample group of teachers, which version would be chosen?

When viewed from the standpoint of how A-V presentations may be improved by the processes of simplification, the foregoing experiments are mere explorations of some of the ways in which this may be achieved. A great deal more experimental work must be done before anyone, with any confidence, can foretell what parts of an A-V presentation can be eliminated without curtailing its effectiveness.

PART V

SUMMARY AND OUTLOOK

The purpose of this paper is to outline problems that need further research in each of the four main areas of motivation, reinforcement, cue identification, and simplification. The long range objective of this research is to formulate guide lines for producers and consumers of A-V materials. At the end of each of the four sections a number of problems, arising from questions left unanswered by previous research, are listed. For convenience of reference, and for providing a quick overview of their number and range, they are summarized below.

Motivators

As stated at the beginning of this paper, learning from an A-V presentation may be described in terms of a sequence of responses, mostly covert, which begin with those involved in paying close and sustained attention, and continue with those of focusing attention on the relevant cues. The next step is to bring the to-be-learned responses under the control of the relevant cues and reinforce them so that they will be recalled in the test situation. A cardinal principle of learning, accepted by all S-R theories, is that a response to a cue cannot be reinforced until it is made in the presence of the cue. The main function of motivators is to drive out, pull out, or otherwise get out the whole range of responses that are essential for learning. The fulfillment or satisfaction of motivators may contribute to reinforcement, but this is a controversial issue among learning theorists that need not concern us here.

Motivators that impel the activities required for learning from an A-V presentation stem from two main sources. One source is the predispositional aspirations, interests and attitudes of students toward school and education in general, and toward the topic and content of the presentation. In a study of the attitudes toward school of West Point Cadets, Carroll found that they could be classified in two groups which he disignated as types A and B. A type A student is an "eager beaver" and hard worker who aspires to get straight "A's" in all subjects regardless of whether he finds them interesting or dull. A type B student is one whose motives for study stem mainly from his immediate interests. He works hardest at subjects in which he is interested and tends to neglect the ones that he finds dull and boring.

A second main source of motivation is inherent in the learning situation. Three main types of situational motivators may be identified. First, the environmental stimuli presented in a classroom tend to have, for many students, acquired motivating powers because of their associations with rewards for paying attention and striving to perform learning tasks. Any stimulus can acquire incentive power by association with rewards. The effectiveness of this source of motivation may be seen by comparing the attention given to an ETV presentation in a classroom and in a home situation. The stimuli presented by a classroom situation are not equally effective for all students. If such stimuli have been associated more with punishment than with rewards, they will have become conditioned to avoidance responses. In this case they will motivate the behavior of getting done whatever is required, so the student can escape from the classroom.

A second type of situational motivation is that produced by the teacher (or an experimenter) just before a film is shown. The devices and procedures used in experiments reviewed in the second section of the first part of this paper belong in this general category of motivators. Motivational introductions may also be built into films. This point will be discussed later.

A third type of situational motivators is embellishments built into presentations to make them more attractive and interesting. The experiments reviewed in the first section of Part I of this paper belong in this category.

A fourth and final source of situational motivation is inherent in the way the subject matter is presented. This includes how it is organized and sequenced, how the visual and verbal components are manipulated, the tone of voice of the narrator and many other factors. It is a well known fact that some teachers can make a dull subject lively and interesting, while others seem to have a talent for presenting interesting material in a dull boring manner.

In summary, the major sources of the motivators that impel the activities required for learning from an A-V presentation are as follows:

A. Predispositional.

1. Generalized achievement or aspirational motivators.
2. Special interests motivators.

B. Situational.

1. The motivating effects of environmental or contextual stimuli.
2. Pre-film motivators produced by teachers or experimenters.
3. Motivational embellishments.
4. Motivational factors imbedded in the manner in which the material is presented.

The experiments reviewed in the first Part of this paper deal only with situational items 2 and 3. There is an obvious need for a program of research that will assess the relative contributions of motivators from all of these sources, and how they interact with each other and with other factors that determine the amounts of knowledge gained from an A-V presentation.

The problem may be approached with different strategies and by the employment of different research techniques. The situational group of motivators can be manipulated experimentally, and the predispositional ones may be controlled by selection or by measurement and covariance. The problem is clearly one of manipulating simultaneously and systematically the situational variables, and at the same time, controlling the predispositional ones and other variables, such as general intelligence, special aptitudes, and previously acquired relevant knowledge. This is manifestly a big order. It would require a series of well-planned and interrelated experiments organized into a program of research.

The experimental work reviewed in Part I of this paper is exploratory in character and provides a fair amount of information that would be useful for planning and executing a more comprehensive program. Before such a program is undertaken it would be well to conduct several more exploratory, single variable experiments as pre-requisites to a more comprehensive program. Below is a sample list of research problems suggested by questions left unanswered by previous experiments.

The experiments indicated that motivational embellishments (type B-3) add little or nothing to amounts of knowledge gained from instructional films. This is attributed to two factors. First, the motivating effects of embellishment are overridden by other stronger motivators; and second, they distract attention from relevant cues. These hypotheses can and should be tested.

1. The overriding effects of situational or contextual motivators (B-1) could be tested by showing a color version of a film in a school auditorium during a recreation period to one group, and the same film in a classroom during class hours to a comparable group. Do the same with comparable groups using a black and white version of the same film. Pre-film motivators could be controlled by omitting them and predispositional ones by covariance, or by randomization of students assigned to the two versions.

2. The effects of predispositional motivators on amounts learned from an embellished and a non-embellished version of a film could be tested as follows. First, divide the experimental students in two groups - those who have high aspirational motives and those whose attitudes toward school and education are apathetic or negative. The latter group would be tested for their interest in the topic of the film, and divided into high and low interest subgroups. Assign students at random from each of the two groups to an embellished and a non-embellished version of a film. Group differences in mental ability and previous knowledge of the subject could be controlled by covariance.

3. The effectiveness of built-in motivators may be a function of the age of students. Most of the experiments reviewed in this paper used subjects in grades five and up. It may be that motivators, such as color, live-action dialogue and humor would be more effective with children in the lower grades.

4. The interaction of pre-film motivators with motivators from other sources has not been determined. The experiments on the effects of pre-film motivators employed films that were not embellished with any of the motivators described in Part I. An experiment could easily be designed which

would test the extent to which the effectiveness of pre-film motivators is contingent upon interactions with other motivators.

5. The extent to which motivational embellishments distract attention from relevant cues could be measured in different ways. Assuming that they carry no additional relevant information, their distracting effects could be measured by the amounts of irrelevant information learned in comparison with the amounts of relevant knowledge acquired. In this connection it will be recalled that the most effective built-in motivators were found to be printed questions spliced into films.

6. It is predicted that built-in devices that make a film more attractive and emotionally appealing will have a greater effect on the amounts of knowledge retained after intervals of delay than on scores of immediate recall.

7. It is further predicted that the greater the number of mnemonic aids that are contained in built-in motivators, the greater will be their effect on retention.

Reinforcers.

The concept of reinforcement has been derived largely from experiments on classical conditioning and instrumental learning in which the to-be-learned responses are overt, and rewards can be manipulated by experimenters. Hence the results of such experiments are more applicable to programmed instruction than to A-V presentations where responses are covert and no provision is made for practice or other forms of overt responding. The reinforcers of such covert responses are difficult to identify and hard to manipulate experimentally.

Two kinds of reinforcement are recognized by experimental psychologists. The first is illustrated by classical conditioning in which the unconditioned stimulus serves to reinforce the power of the conditioned stimulus to evoke the to-be-learned response. This form may be called instigational reinforcement because it occurs before the response is made. The other type is illustrated by operant conditioning where the application of the reinforcer is contingent on the occurrence of the to-be-learned act. This type may be called consequential reinforcement, or reinforcement by reward.

An instigational reinforcer is like a motivator because it serves to evoke the to-be-conditioned response. The justification for calling it a reinforcer is that it increases the probability that the conditioned stimulus will elicit the conditioned response. A consequential reinforcer has the effect, sometimes but not always, of removing the drive stimulus. It may also have the effect of satisying a need or incentive, getting something that the learner wants, or getting rid of or avoiding something he doesn't want. The consequence is "a satisfying state of affairs". A consequential reinforcer is a stimulus that has the power, either native or acquired, to elicit a neural response of satisfaction or confirmation.

The problem is to discover how each of these two kinds of reinforcers operate and interact to fixate new knowledge or skills gained from an A-V presentation. This discovery is contingent upon the ability of an experimenter to manipulate these reinforcers experimentally and in relation to other conditions on which learning depends. The instigational type can be manipulated by varying the relations between the visual and verbal components of a film. One of the main functions performed by visuals is to illustrate and otherwise reinforce the responses of getting the meanings of the verbals (see May and Lumsdaine, 1958, p. 166). This function will be discussed at some length in a subsequent paper on the roles of words and pictures in learning from A-V presentations.

The consequential type of reinforcers are harder to identify in A-V presentations that make no provision for overt responding. The satisfactions a student may get from having received new information, grasped a new idea, or gained an understanding of a principle, are not easily determined. It may be that such responses, like virtue, are their own rewards. There is no doubt that an individual can congratulate himself on having solved a problem, or gotten hold of a new idea. But the new information conveyed by a film may come much too fast to permit time for silent verbal self-congratulation. The experiment by Greenspoon and similar experiments by others demonstrate that a subject may be quite unaware that he is getting a reinforcing stimulus. It might be worthwhile to compile categories of stimuli that have been found to be reinforcing, and then count how many occur in a film or an ETV program.

The experiments on the relations between liking and learning leave unanswered a number of questions that require further investigation. One possible explanation for the low correlations between liking and learning is that students tend to like the parts of a film that convey previously acquired knowledge as well, if not better than, the parts that convey new knowledge. If liking is considered to be a manifestation of reinforcement, it would appear that students tend to derive as much self-reinforcement from being presented with materials previously learned, as from the satisfaction derived from the acquisition of new knowledge. Becker's experiment contains some interesting suggestions on how this problem might be approached.

According to the second type of predispositional motivators, a student would be expected to learn best the materials that appeal to his special interests. But, according to the first type, he would be expected to learn dull or uninteresting materials provided he perceives it as counting in his grades or instrumental to other aspirations. Such a student might rate a presentation as dull and boring but still show a substantial gain in knowledge. Hence, the significant variable in self-reinforcement might be called "perceived consequentiality". Responses to an A-V presentation are self-reinforcing to the extent that they are perceived by the learner to satisfy his predispositional motivations. But if the material is perceived, as a trial lawyer would say, to be "irrelevant, incompetent, and immaterial", it will not be well learned unless the learner is motivated by some powerful situational motivator. Even the "eager beavers" may balk at learning nonsense materials, unless they serve as experimental subjects in a laboratory experiment.

One approach to this problem would be to devise a test or questionnaire, to be applied immediately after a film has been shown, containing questions such as (1) What new knowledge or information did you get from this film? None, little, some, much, a great deal. (2) Did you get out of it what you expected you would get? (3) What uses, if any, do you expect to make of it?

Because of the dependence of consequential reinforcers on the predispositional types of motivators, a program of research on reinforcement would need to be articulated with one on motivation. Also the instigational types of reinforcers are related to, and interact with, the situational types of motivators. More exploratory experimentation needs to be done to identify more clearly the basic variables to be manipulated or controlled. Below are some problems suggested by previous research that may profitably be investigated.

1. One problem is to find the relation between "perceived consequentiality" and amounts of knowledge gained from a film. This problem could be approached by finding the partial correlation between amounts of

knowledge gained and results obtained from a measure of perceived consequentiality, with other variables on which learning depends held constant. A better approach might be the analysis of variance technique.

2. The problem of the relation between manifestations of interest and learning should be further investigated by following up a result obtained by Becker, who found that expressions of interest occurred more frequently at points in a presentation where learning occurred than where it did not occur.

3. The extent to which muscular tensions, appropriately measured, contribute to learning from A-V presentations should be investigated.

4. Another aspect of reinforcement could be investigated by varying the realism or "iconicity" of the visuals, keeping the verbal content constant. The theory is that the more realistic the pictures are, the greater will be their capacities for reinforcing the verbals. The visuals could be varied from highly authentic photographs to pencil sketches and schematic diagrams.

5. Still another approach to the same problem would be to test the hypothesis that a narrator "on camera" teaches more effectively when he is doing something than when he does nothing but talk.

6. If it is true that the covert responses required for learning from an A-V presentation are largely self-reinforcing, then the task of getting correct ones is of paramount importance. With motivators from two or more sources bearing down on the learner, one would suppose that failure to learn would not be due to a lack of motivation. These motivators, however, may be acting only on the responses of attending and not eliciting active efforts to learn. It could be that the situational stimuli have become more conditioned to the relaxing and passive responses of letting it soak

in, than to the active responses required for learning. Children have had so much experience in relaxing in front of a TV screen, that the very sight of a set may elicit relaxation.

In this connection two experiments by Gropper and Lumsdaine (1961) are instructive. They programmed two or three ETV lessons and compared the results with the same material presented in the usual TV way. In the programmed lessons the teacher would leave sentences incomplete and a question mark would flash on the screen. The students were instructed to complete them silently or to write answers on their work forms. Under one condition, the teacher would give the correct answers, and under another, it was not given. The authors found that the programmed form of the lessons was significantly more effective than the regular TV form. They attributed this result mainly to the fact that the students were encouraged, and given time, to respond rather than merely to sit back and let it soak in, as they are so accustomed to doing while watching TV.

These observations suggest an interesting hypothesis that could be tested experimentally. In view of the fact that many children have enjoyed relaxing before a TV screen and also have been rewarded for attending and learning from films in school, it would be predicted that they would learn more from a kinescope of an ETV program shown on a movie screen in school, than they would from the live program shown on ETV in school.

Cue Identifiers.

The main reason for the employment of devices and procedures for directing attention to the relevant parts of a presentation and for focusing it on crucial cues is that most A-V presentations contain varying amounts of materials that are irrelevant to the learning task. Because attention is a selective and shifting process, if it is deployed on irrelevancies, less time is left for attending to the relevants. As an experiment by Harris (1962) indicates that one of the reasons why some students do not learn more from a presentation is that they are too preoccupied with attending to irrelevant parts of the material.

Experiments on the effectiveness of various procedures and devices for directing attention to relevant cues have, on the whole, been quite successful. The films used in these experiments have been mostly training films. It is possible that learning from instructional films might be improved by the use of the same or similar devices. Experiments are needed in which such devices are employed in many different types of films.

The variables on which the effectiveness of cue identifiers depends have not been explored systematically. Among them are: (a) the nature of the learning task, (b) familiarity of the students with the materials, (c) the amounts of irrelevant materials in the presentations, and (d) the number of stimuli in the relevant materials that are known to have power to attract attention. Special devices such as arrows, labels, and other kinds of pointers are needed only when the attention-attracting power of the irrelevant cues is greater than that of the relevant ones.

A program of research is needed in which the variables on which the responses of selective attending to relevant cues depend are explored systematically. The purpose of such a program would be to establish some general propositions that state the conditions under which the effectiveness of various devices and procedures for facilitating selective attention could be predicted.

The following are a few hypotheses that may be tested experimentally.

1. Psychological research indicates that contrasts will attract attention. One type of contrast is between colored and achromatic stimuli.

One of the reasons why color has been found to be ineffective for cue discrimination and identification is that the films used in such experiments are entirely in color or entirely in black and white. It is predicted that if a film could be constructed so that only the relevant cues are in color and the irrelevant ones in black and white, the employment of color would be much more effective.

2. Any sudden change in a stimulus pattern has been found to attract attention. In the experiment on micrometer reading by Lumsdaine, Sulzer and Kopstein (1961) the attention-getting arrows and labels "popped" on and off the screen. The significant element here may have been the sudden popping on and off of a stimulus, rather than the nature of the stimulus. This suggests that if a film could be constructed so that the relevant cues appear and disappear suddently rather than appear continuously, learning might be made more effective.

3. It has also been found that anything that emphasizes or exaggerates relevant cues so that they are made to stand out as "figure" against a background of irrelevant stimuli will attract attention. In the visual displays, printed words synchronized with certain key sentences uttered by the narrator should have the effect of emphasizing relevant cues.

4. Another factor that controls attention is expectancy. People generally are inclined to see what they are looking for, and hear what they expect to hear. This expectancy could be induced either by pre-film instruction or by the narration, or both.

5. Stimuli that arouse curiosity are apt to attract and hold attention. Stimuli that elicit a "what is this?" response are usually unfamiliar. The more unfamiliar a cue is to a learner, the more likely it is to attract attention; the greater the familiarity with it, the greater

will be the probability that it will be recognized as important when it appears. This paradox should be investigated.

6. In regard to the problem of measurement, Guba and Wulff (1963) have developed an instrument for monitoring and for recording the eye movements of subjects as they view a visual display. This instrument could be used to measure the effectiveness of a variety of attention-getters.

7. Earlier in this paper it was suggested that post-tests do not, as a rule, measure all that a student may learn from a film or from an ETV program. As illustrated by Harris' experiment, students often learn a great deal that is irrelevant to the learning task. One crude measure of the extent to which a student devotes attention to the relevant parts, could be measured by how much irrelevant material was learned in proportion to the amount of relevant knowledge gained.

Simplifications.

This problem area is much too broad and complex to be treated in terms of a few basic variables as was suggested in the three preceding areas. A grand experimental design that would include and vary systematically all of the ways by which an A-V presentation could be simplified is beyond the imagination of this writer. The only feasible approach is to consider the problems one at a time. Research problems suggested by the experimental literature are listed in Part IV. of this paper. They are summarized here for reader convenience.

1. Lathrop's study of introductory sections should be repeated. Alternate versions of an introduction to a film could be constructed for the explicit purpose of performing one or two functions. These functions may be (a) clear definition of the learning task, (b) what to look for,

and (c) the perceived importance of the material by the students. Such introductions could be varied in length, in relation to the length of the film, and in respect to visual and verbal techniques employed.

2. Another problem is to reconcile the results of the four different experiments on review sections. These sections vary in respect to length, spaced and massed review, and learning tasks. Review sections should obviously be planned to perform certain functions such as (a) overlearning the learned parts so that they will be better retained, and (b) motivating the learner to pursue the topic further. The variables to be manipulated are the length of the review section, the functions to be performed, manner of presentation, and whether review is spaced or massed at the end.

3. The number of illustrations, examples, or demonstrations required to maximize the achievement of the learning task has been investigated only in training films. One general conclusion derived from these studies is that the gain in learning from examples is roughly proportional, up to a point, to their numbers. But no general principle has been found from which this limit could be predicted. The number of illustrations or examples in an instructional film have not been systematically varied. Cue discriminations in concept formation require a number of examples in which the contextual stimuli are varied. The effectiveness of increasing the number of illustrations in instructional films may be found to depend on (a) the nature of the learning task, and (b) the previous knowledge which the students have of the subject.

4. The problem of whether a simplified version of a film shown twice or more will be more or less effective than a version twice as long but embellished with built-in motivators, cue identifiers, and illustrations

remains to be resolved. What is needed is a general principle from which could be predicted which of the two would be more effective for different types of learning tasks, audience characteristics and other conditions of learning.

5. Mercer (1952) found that optical effects such as wipes, dissolves and fades have little or no advantage over straight cuts. McIntyre (1954) found that labels and even blank spaces between sequences are better than optical effects. The problem is how build into a film a device that parallels the paragraphing of a textbook, to notify the learner that the subject has changed, or that a new idea is coming up.

6. Three experiments have been reported on the simplification of the narration by applying readability formulas, Allen (1955), Moldstad (1955) and Gladstone (1958). Both Allen and Gladstone found that when the readability level of a narration, as measured by the Dale-Chall formula, is one grade below that of the students, gains in knowledge are reliably greater than when it is one grade higher. But Moldstad's experiment failed to confirm this result. The conditions of his experiment, however, were different from those of Allen and of Gladstone. Moldstad's film on the Life of a Plant was shown twice before the post-test, the films used by Allen and by Gladstone were shown only once. The visuals in Life of a Plant were considered to carry a heavier burden of the teaching load than the visuals in What is China? (Gladstone), or in The Mosquito and The Water Cycle (Allen). Also, Moldstad's film was more difficult than Gladstone's as indicated by the fact that the percentage of the room for improvement that was filled by seeing the film twice was 29% which compares with 50% for Gladstone's film which was shown once.

These results would seem to point to two variables on which the effectiveness of a simplified narration depends. One is that the greater the proportion of the instructional load that is carried by the visuals, the less effective will be the simplifications of the verbals. The other is that the greater the difficulty of the materials for the subjects, as measured by pre-test scores, the less will be the effectiveness of simplifying the narration. But these two principles may interact in such a way that the second is true only when the heavier load of information is carried by the visuals. Here is an hypothesis that should and could be tested experimentally.

7. The practical problem of the extent to which simpler forms of presentations such as filmographs, filmstrips, and slides can be substituted for more complex forms cannot be decided on the basis of general principles. There is some evidence that a crude filmograph made from story-board pencil sketches is just as effective as a much more expensive finished production (Lumsdaine, 1958). There is also evidence that a filmstrip made from frames of a motion picture will teach almost as much as the film (Zuckerman, 1954). There is a possibility, as suggested by Lumsdaine and May (1964), that motion might be successfully depicted in filmstrips by the employment of "swish" lines.

8. Finally attention is called to a very important limitation that is placed on the extent to which A-V presentations can be simplified. It is a limitation imposed by the standardization of 16 mm. motion picture reels of 400 feet and multiples thereof. For several years Lumsdaine has been advocating the development of an inexpensive magazine type of projector that will take cartridges of any length, from a few feet up to the standard 400 foot reel, which can be projected on a built-in screen. Such a

machine would be extremely useful not only for increasing the extent of use of films by teachers, but also for experimental research.

Conclusion

This brief summary of the results of experiments reviewed in this paper and of problems for future research suggested by unanswered questions should serve to outline three or four broad problem areas that require, for their adequate study, comprehensive programs of research that might extend over several years, require a great deal of time, and cost a lot of money. In addition, a number of small and more easily managed problems have been suggested, some of which might be suitable for a master's essay, or for a Ph.D. dissertation.

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